

SIXTY-NINTH YEAR

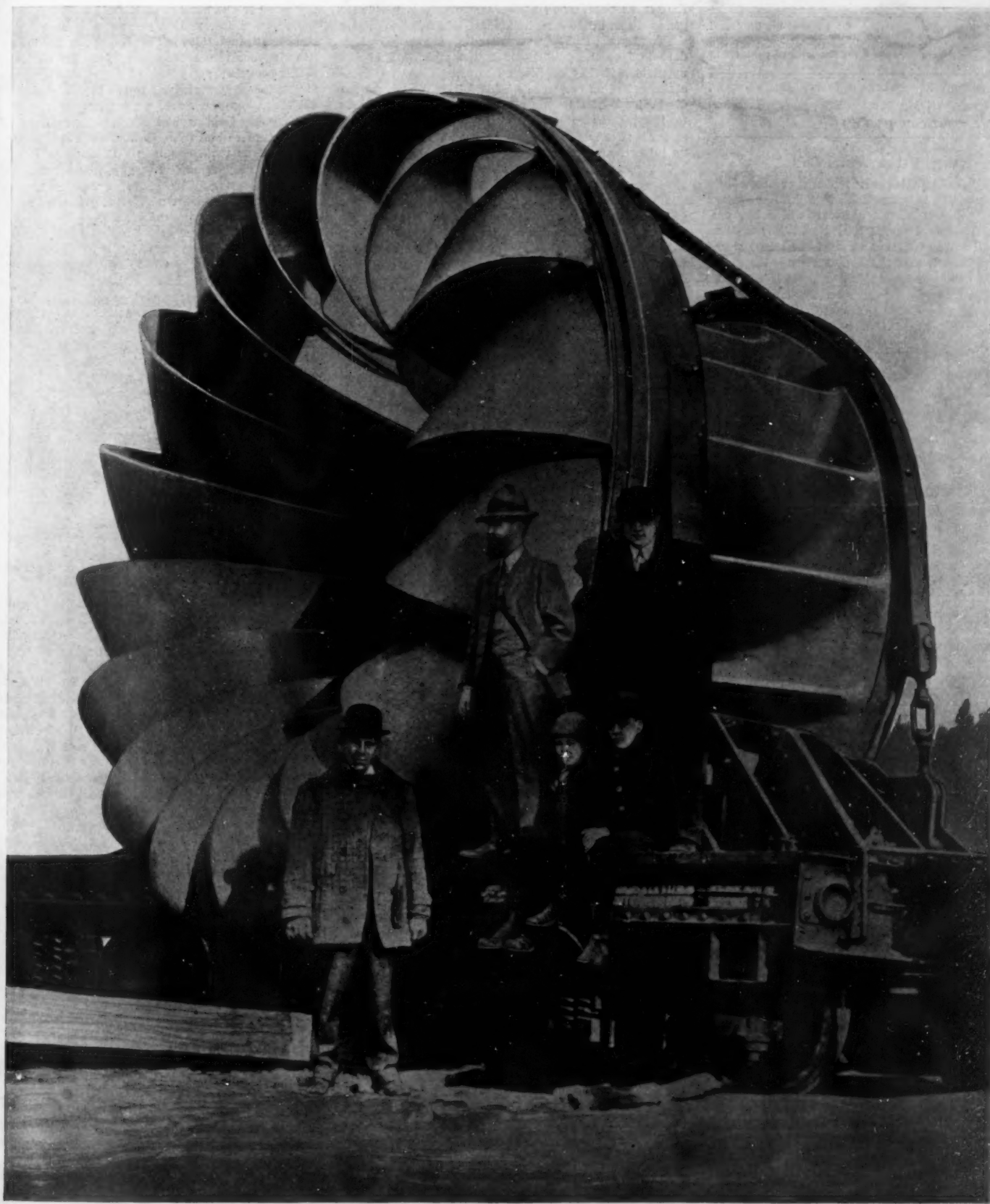
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CIX  
NUMBER 11.

NEW YORK, SEPTEMBER 13, 1913

PRICE 10 CENTS  
\$3.00 A YEAR



Photograph of Ansbach.

One of the turbine wheels. Diameter, 16 feet 2 inches. Weight, 73 tons. Horse-power, 10,000.

THE 300,000 HORSE-POWER MISSISSIPPI POWER PLANT.—[See page 212.]

# SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, SEPTEMBER 13, 1913

Published by Munn & Co., Incorporated, Charles Allen Munn, President  
Frederick Converse Beach, Secretary and Treasurer  
at 361 Broadway, New York

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Subscriptions for Foreign Countries, one year, postage prepaid	4.50
Subscriptions for Canada, one year, postage prepaid	5.75

## The Scientific American Publications

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Scientific American Supplement (established 1876)	" " 5.00
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*The purpose of this journal is to record accurately,  
simply, and interestingly, the world's progress in sci-  
entific knowledge and industrial achievement.*

## Reaping the Whirlwind

**D**ISREGARDING the secondary or immediate causes of the succession of frightful disasters on the New Haven Railroad which has culminated in the recent wreck near North Haven, Connecticut, and taking a broad view of the whole situation, it may be said that these disasters are the bitter fruit of the policy under which the great system has been controlled during the past decade. As proof of this we submit the following propositions:

1. In the event of collision, a modern express passenger train, say, of ten Pullmans, drawn by one of the latest heavy express engines, represents when moving at 60 miles per hour, a smashing energy equal to twice that of a 12-inch projectile discharged from a modern dreadnought.

2. Since the accidental impact of this flying mass, with its precious human freight, would mean the instantaneous development of over 100,000 foot-tons of energy, it is evident that the very first consideration of good railroad management should be to provide for its smooth and safe transit from place to place, by making use of every known physical and human precaution against derailment or collision.

3. In view of the inestimable value of the human freight carried and the enormous and ever insistent perils which beset these heavy and fast-flying trains, it becomes the duty of the directors of the road to give the question of safe construction and operation the first place—to see to it that the first appropriations from the treasury are those which are made for the maintenance in absolutely first-class condition of tracks, rolling stock, and general equipment.

4. Since the risk of travel are broadly proportional to the density of travel, it follows that the duty of maintaining the physical properties in absolutely first-class condition is particularly imperative in the case of railroad systems such as the New Haven Railroad, whose passenger traffic is one of the densest and most remunerative in the world.

5. So far as the track and roadbed are concerned, the dangers of fast passenger travel may be reduced to a minimum by the provision of heavy and well spliced rails, with tie-plates interposed between rail base and tie; by the close spacing of the ties, and the maintaining of them, by continual renewals, in first-class condition; by the provision of ample stone ballast; by the continual improvement of the track through the removal or easement of sharp curves, and the maintenance of outer rails on curves at their proper superelevation; and by the elimination of old-fashioned cross-overs with abrupt turnouts, and the substitution of long cross-overs, suitable to modern, high-speed traffic.

6. For the prevention of collision it is absolutely necessary to maintain between these heavy and fast-flying trains a proper time and space interval, and to provide a system of signals by which it will be impossible for successive trains to come within certain specified distances of each other. Since the introduction of the block signal system has offered a means of doing this with practically absolute certainty, it is the duty of the directorate of a first-class and wealthy railroad to see to it that its signal system is of the latest and most perfect pattern, and to see to it, also, that the running rules are such as to prevent any playing fast-and-loose with the automatic mandates of this mechanism as thus applied.

7. Since the protective value of signals depends upon the intelligence and discipline of the train crew, and collisions due to human fallibility are frequent, it becomes the duty of good management to reinforce its block-signal system with some form of automatic

stop, which will correct the mistakes or carelessness of the train crew, and enable the signal mechanism to stop a train should the engineman fail to do so.

8. The most perfect equipment is liable to failure, and collisions may occur on an absolutely first-class road. Hence it becomes the duty of good management to mitigate the disastrous effects of collision by building its rolling stock of such strength and of such materials, that the killing and wounding due to such collisions will be reduced to a minimum. Since the experience already had with steel cars has shown them to be a most effective protection to the passengers in the event of collision, it is evident that a conscientious directorate and management will bend every effort to the earliest possible substitutions of a steel for a wooden car equipment.

9. Finally, realizing how greatly the efficiency of the most perfectly built and equipped road depends upon the human element, an efficient management will do its utmost to maintain a high standard of discipline among the employees; and knowing that the unions will never dare to face the public opprobrium which would fall upon them if they endeavored to bring about the reinstatement of an employee who had been discharged for disobedience of rules, an efficient management will see to it also that its subordinate officials are always strongly sustained when an employee is discharged for an infraction of the rules.

Ten years ago the great railway system which has recently attained such an unenviable notoriety for the number and magnitude of its railroad wrecks, was one of the best equipped and best operated railroads in the country. The character of its roadbed and rolling stock and the general safety of its operation compared well with those of other leading railroads—a condition of affairs which was reflected in the high quotation of its bonds and stocks in the money market. At that time, however, there was change of management and directorate policy to which, more than anything else, are to be attributed the present deplorable conditions.

There was conceived and put in operation an ambitious scheme for the shutting out of competition and the acquirement of a complete monopoly of transportation, which was revealed in the wholesale buying up of all possible means of transportation, whether by rail, trolley, river, or ocean. Appropriations which should have been made for the improvement of the existing roadbed and the construction of additional tracks to accommodate the rapidly growing traffic; for the elimination of short cross-overs and other defects of track layout which had been left over from earlier years; for the bringing of the rolling stock up to modern standards; for the substitution of steel for wooden cars; for the development of the block signal system; and for the thousand-and-one improvements which are continually necessary to meet the conditions of first-class railroading as outlined in the several propositions above given—these appropriations must necessarily have been diverted very largely to furthering the ambitious scheme of enlargement and consolidation to which we have referred.

Contemporaneously with this curtailment in the funds applied to the physical upkeep and improvement of the properties, there has undoubtedly been a deterioration in the discipline of the road. Anyone who has followed carefully the various official investigations of the many railroad wrecks of the past two years must have been convinced of this. The frequent overrunning of signals, the placing of comparatively raw men in charge of important express trains, the failure of flagmen to go back over the distances specified for the protection of trains, coupled with the continual complaint of the management that it was hampered by the unions in the effective maintenance of discipline, suggests that in its anxiety to prevent the great loss of revenue due to strikes, there may have been a failure on the part of the officials higher up to give that hearty endorsement which is necessary, if the lower officials are to hold their men rigidly to the rules and regulations.

In view of the pending official investigations, it would be out of place to give any definite opinion as to the immediate causes of the recent accident; but there are certain facts, of public knowledge, which are sufficient to explain the terrible loss of life which occurred. We refer to the old "banjo" system of signals, extremely difficult to see under the condition of fog which prevailed at the time of the accident; to the fact that the flagman went back only 400 feet when he should have gone back half a mile; to the absence from the heavy train of Pullmans of a single car of steel construction; and to the fact that the engineman was running much faster than he should have done under the weather conditions that prevailed.

## The Natural Time Unit in the Organic World

**I**N our days all sciences, including biology, have become quantitative. We no longer ask merely, what has been the course of evolution in the past, but we particularize—we ask what is the age of the human race? or, how long must it have taken for man to

evolve from a primitive savage condition to the present civilized state? Is the time required for such changes by the theory of evolution in harmony with what we know of the age of the earth and its several geological strata? For it must be remembered that, however great this age may be, it is not infinite, and if we are to accept the theory of evolution, we must first be convinced that there has been time for the supposed changes to have taken place at the rate implied by the theory.

Now, whether we suppose that new species arise by the gradual accumulation of slight variations of the offspring as compared with the parent, or whether we assume that mutation—sudden radical departures from the parent stock—play an important part, in either case the natural time unit to employ is the average length of one generation, or, to be more exact, the average difference between the age of the parent and its offspring. For the number of cumulative variations in a given line of descent in a given time cannot exceed the number of generations in that time. Let us take an illuminating concrete example. If you, the reader, could gather together every one of your male ancestors in direct line of descent, back to the year one of our present reckoning, you would see before you a small band of not more than about sixty-five men! Even assuming that there had been, during these last 1900 years, a continuous variation in one direction in some characteristic of your ancestry, you would hardly expect your great grandfather sixty-five-times-removed to be very different from the men of our time, so far as his biological make-up was concerned.

But with the lower organisms the situation is very different. In the case of the house-fly the length of one generation is about 12 days, and in the recent experiment of Guyenot, a line started in May, 1911, has now passed its fortieth generation—representing about 1200 years of human history. And this is a mere trifle as compared with the conditions prevailing among very low forms of life. Miss L. L. Woodruff isolated a paramoecium (slipper animalcule) on May 1st, 1907, and carefully followed up its progeny. In the five years from the date of inception of the observations, to 1912, she counted 3,029 generations. The number of animalcules produced in this time is 2 raised to the 3,029th power, an absolutely unthinkable multitude, and their volume, had they all been preserved, would have been about ten thousand times that of the earth. With such rapid succession of generations we may well expect marked evolutionary changes within historic times, or even within the course of a few years.

## The Aviation Lessons Taught by the Tripolitan and Balkan Campaigns

**T**HE lessons taught in recent European army maneuvers were confirmed and corrected in the Balkans. France and Germany are already fully equipped and organized for waging real aerial war, the one in aeroplanes, the other in dirigibles. The maneuvers of Austria and of England have shown that they too are prepared, although to a more limited extent.

The war in Tripoli taught us more of the possibilities of aircraft than the campaign in the Balkans. In Tripoli the climatic and geographic conditions were so favorable that, despite an utter lack of aerial organization, the Italians were singularly successful in the air. In the Balkans, the climate, local conditions, and the geographic panorama offered difficulties which showed the absolute necessity of an organization of the kind thus far wholly provided for only by France and only partially by Germany.

The opponents of the Italians in Tripoli were composed chiefly of Arabian irregulars and comparatively small Turkish forces of regulars. In the Balkans, on the other hand, there were on both sides great masses of regular troops, improved artillery in great quantity and strong fortifications. In Tripoli the aeroplanes, much to their advantage, were always able to return to the same camp, where they could be well cared for.

Tripoli is a sandy desert, quite flat, with an occasional oasis. Actual fighting there was confined to a comparatively small area. The aeroplanes were not even required to follow troops on extended marches, because there was no object to march for. The country has no resources, few cities and only a floating population living in tents and shifting from oasis to oasis. The enemy was naturally very elusive. Forces of Arabian irregulars appeared to-day only to disband again to-morrow. Hence the air scouts were often hard put to it to find them; but in this task the simplicity of the landscape and the marvelously clear sky were of great assistance.

Neither in the Balkans nor in Tripoli had the aviators an official military standing and rank. They were not organized into a "fifth arm." In the second half of their campaign the Italians enlisted civilian fliers. In the Balkans the civilian trainers of the officers followed their pupils into the field. Moreover, many foreign civilian pilots were employed by the allies.

## Electricity

**Electrolytic Cleaning.**—A patent, No. 1,068,568, has been issued for an apparatus for cleaning articles electrolytically. A chamber confines chemicals and gases, and a movable belt of electrolytically active material carries the article into and from the chamber. The liquid supplied to the chamber is such as will react with the electrolytically active material, electrolysis taking place and cleaning the article and removing the tarnish and all foreign material.

**Westminster Abbey Electrically Lighted.**—During the coronation of King Edward VII, in 1902, Westminster Abbey was temporarily equipped with electric lights. Again electric lights were used at the coronation of King George V. Now the temporary installation has been enlarged and made permanent. The Abbey is equipped with 50-watt, 250-volt metal filament lamps, operated on a 200-volt circuit. The organ is also provided with two blowers, each driven by a 5½-horse-power motor, operated on a 400-volt circuit.

**The Wireless Station on Macquarie Island,** which was established by Dr. Mawson's antarctic expedition, is reported to have been taken over by the government of Australia to serve as a permanent weather station. Situated midway between Australia and the antarctic continent, its reports will be of immense value to the weather forecasters of the commonwealth. The meteorological outpost maintained by the Argentine government in the South Orkneys, in a higher latitude than Macquarie, has not at present any telegraphic communication with the world, but the erection of a wireless station there has become a practical question on account of the important whale fisheries in that vicinity.

**Wireless and Weather.**—Writing in a recent number of the *Electrical World*, A. H. Taylor tells of his investigation of the effect of weather on the transmissivity of wireless telegraph signals. He has found that transmission is in almost every case particularly favorable when cloudy weather prevails between the communicating stations. When the area is only partly cloudy he is inclined to think that transmissivity is better when the sun is shining upon the receiving station and its neighborhood rather than the vicinity of the transmitting station. But in such case the transmissivity is not so good as when the cloudy area includes both receiving and transmitting stations.

**To Electrify the Norfolk and Western Railroad.**—Contracts have been let by the Norfolk and Western Railroad to electrify the Bluefield-Vivian section, which is 85 miles in length. An overhead trolley system will be used like that of the New York, New Haven and Hartford Railroad. Single-phase 25-cycle alternating-current will be supplied at 11,000 volts pressure. Over this line 65,000 tons of coal are handled per day. Twenty-six 130-ton electric locomotives have been ordered, adapted to run at speeds of from 7 to 26 miles per hour. The line includes a 3,000-foot tunnel, which is very difficult to ventilate. The electrification of the line is to be completed next summer.

**Dementia Telephonica.**—An indiscreet Berlin lawyer says *Medical News* was adjudged guilty of slandering the post-office administration, which controls the telephone system under the Teutonic polity. The particular offense of this Berlin attorney was that he called telephone girls "camels" and "sheep." The culprit's defense was that telephone operators delight to torture the victim at the end of the wire; one day he had called a number nine times within three quarters of an hour and each time had received the tantalizing answer that "the wire is busy"; complaining then to the central manager he learned that his connection had been free all the while. The court's medical expert testified after an examination of the defendant that the latter was of a highly nervous temperament, and that there were cases of men who had gone insane from telephonic vexation (*Telephonärger*), but that nevertheless he had not as yet passed the state of legal responsibility. He was fined 260 marks (\$65).

**Chrono-Photographs of Hertzian Waves** have been made with great precision by H. Abraham with his new apparatus that includes a Carpentier galvanometer designed for rapid movements which reflects a beam of light upon a moving photographic band. Mounted as a receiver for wireless waves, this apparatus gives a continuous record and is very sensitive, as his records prove, for these give very clear and fine traces of the waves. Using a small mast in the grounds of the Paris Observatory, he received waves from the German Norddeich post, these being taken down on the paper strip together with seconds marks from the Observatory clock. He took down waves from the Eiffel Tower in the same way, and can measure time down to a thousandth of a second on these records. He claims to be able to estimate one forty thousandth of a second on the wave charts, and intends to apply the method for direct graphic measurements of wave speed at the earth's surface. Using a suitable clock and electric time recorder, he is thus enabled to give close measurements of the duration of waves when working between two stations. Time records can also be made by using tuning forks.

## Science

**A School of Pisciculture** is to be established by the provincial agricultural council of Bohemia at Eger.

**The Largest Searchlight in the World** will, it is reported, be installed on Mount Tamalpais as a feature of the Panama-Pacific Exposition.

**The Mawson Relief Expedition**, commanded by Capt. J. K. Davis, is to sail from Melbourne for Mawson's headquarters at Commonwealth Bay the last week of November, and hopes to be back at Hobart with the whole party by February, 1914.

**A Statue of Lord Kelvin** will be unveiled at the University of Glasgow on October 8th by the Lord Rector of the university, Mr. Birrell. The Kelvin memorial window in Westminster Abbey was unveiled on July 15th.

**An Experimental Study of Ventilation Problems** will be carried on for the next four years by a commission having at its disposal a fund of \$50,000, which is part of a gift made by Mrs. Elizabeth Milbank Anderson to the Association for Improving the Condition of the Poor. The chairman of the commission is Dr. Charles Edward A. Winslow of New York.

**Radioactivity of the Atlantic and Pacific.**—An Argentine scientist has made a series of fifty measurements of the radioactivity of the oceans, fifteen in the Atlantic, south of Montevideo, four in the Magellan Straits and thirty-one in the Pacific, south of Callao. The radium emanation value, expressed in Mache units, was 0.14 for the Atlantic ocean; 0.09 for the Straits and 0.03 for the Pacific.

**A New Vegetable Ivory.**—According to a consular report, M. Gaston Bonnier has submitted to the National Agricultural Society of Paris samples of a new vegetable ivory made from the albumen of the fruit of a certain small palm, of the genus *Hyphæne*, growing in the forests of the French Sudan. The product is said to resemble strongly that of the ordinary ivory-nut (*Phytelphas macrocarpa*) of South America. The nut of the doom-palm (*Hyphæne thebaica*) has long been used for making rosaries and small ornaments.

**A College of Tropical Agriculture.**—The project of establishing a college of tropical agriculture is being extensively agitated in Great Britain. The Board of Agriculture of Ceylon has appointed a London committee to arouse public interest in the question. At the annual meeting of the Ceylon Association, held in London June 12th, it was unanimously resolved that the association approved of Peradeniya, Ceylon, as the best site for the proposed college. The famous Royal Botanic Gardens are situated at Peradeniya, which is a suburb of Kandy.

**Gas in the Cavities of Trees.**—Prof. J. A. Ferguson, of the Pennsylvania State College, reports a curious phenomenon connected with the cutting of hardwood trees in the Ozark Mountains. Cavities near the base of the trees are often found to contain gas. When these cavities are cut into by the oak tree cutters of the region the gas escapes with a whistling sound, showing it to be under pressure, and if lighted it will burn with a faint yellow flame. The sides of the cavities containing gas are in all cases darkened and look as though seared with a hot iron. The popular belief of the district is that these trees are connected through their roots with a subterranean supply of natural gas, and the land on which they grow is valued accordingly. An examination of the gas collected from a cottonwood tree was made by Prof. Bushong, of the University of Kansas, and it was found to be substantially the same as natural gas with the addition of some free hydrogen. Prof. Ferguson believes, however, that this gas is the product of decomposition of the heartwood of the trees.

**Studying Taal Volcano.**—With the aid of a special appropriation of \$9,000 from the colonial legislature, the Philippine Weather Bureau has established a seismological station on the shore of Lake Bombon or Taal, about five miles from the volcano that caused so much destruction in January, 1911. The building, which is of reinforced concrete, is situated about twenty feet above the level of the water, and thus commands a view of the lake and the volcano (the latter being on an island in the middle of the lake). The location is near the ridge of a fault which radiates from the volcano in a nearly southwest-northeast direction, and so is expected to be very favorable for registering the slightest shocks having their origin in the volcano. The practical purpose of the institution is to obtain timely warning of any impending eruption and warn the inhabitants of the district. The station is equipped with meteorological instruments, a Vicentini microseismograph, and an Agamennone seismograph; also with a Friez water-stage register, a set of underground thermometers, for use on the island of the volcano, and two small deep-sea sounding thermometers for locating some of the subterranean steam vents that are supposed to exist around the volcano. A fine motor launch completes the equipment.

## Aeronautics

**German Military Dirigibles.**—The German army has increased its supply of airships this year by eight, namely, four Zeppelins, two Parsevals, one Schütte-Lanz and one airship of "M" type, making a total of thirteen dirigibles now at its disposition.

**Another Gyroscopic Attachment for Flying Machines.**—Herbert E. Hawes, of New York city, has patented, No. 1,067,425, a flying machine which includes means for inclining the balancing planes during their lateral displacements which include a gyroscope whose vertical shaft is mounted on an oscillable bearing and means co-operating with the shaft so that the inertia of the gyroscope co-acting with a laterally tipping frame through suitable connections operates to incline the balancing planes.

**Another Gyroscopic Stabilizer for Aeroplanes.**—A gyroscopic stabilizing device is shown in patent No. 1,066,860, to Edmund Sparmann of Vienna, Austria-Hungary. The patent presents in connection with other features coupled double gyroscopes which are able to effect symmetrical movement relatively to the vehicle and also means for locking the gyroscope when the aeroplane is to be controlled by hand, as in ascending, descending or rounding a curve.

**A Gyroscopic Controller for Flying Machine.**—In a patent, No. 1,063,432, Edward D. Green of Chicago presents a flying machine in which a gyroscopic wheel is rotatively mounted on an axis coincident with the axis of the propeller with a rim incircling the propeller. If in operation the motor breaks down or the propeller ceases to revolve from any cause, the gyroscopic wheel, on account of its momentum, will continue to revolve independently of the propeller, thereby resisting any effort on the part of the machine to topple over. By changing the machine's course down, the momentum may be reacquired.

**Three-dimensional Warfare.**—In the two-dimensional warfare of the past the rear ranks have always been held in reserve. In the three-dimensional warfare of the future, when dirigibles and aeroplanes will be used, no part of an army will remain idle for any great length of time. If it is not actually used to attack it will be busily engaged in resisting attack. In that conflict of the future it is not unlikely that aeroplanes will be used in ways undreamed of now. If we cause a squadron of aeroplanes to fly low and thus convert them into a novel cavalry of unlimited speed and endurance, new possibilities dawn upon us. Because the machines fly in three dimensions, because they are speedier than horses, because they are numerous, they need not fly in rigorous formation. They can attack the enemy from any direction. That aeroplanes may become great fighters as well as great scouts is shown by the simple philosophy that the fighting power of mounted men rests in the strength of their horses. How can we contemplate the tremendous concentration of brute force in a 100 horse-power aeroplane carrying two men and not conceive of aggressively employing this power? Travel swiftly and you are safe from fire no matter how close it may be at hand. Rush past a rifleman at sixty miles an hour and he will not be able to hit you, although the distance be only a hundred feet. All that this implies is courage—the soldier's stock in trade—as well as skill enough to navigate the turbulent, swirling ground current, and a motor that will not fail at the crucial moment.

**Distinguishing Friend from Foe in the Air.**—In time of war it would surely be difficult to determine the nationality of an aeroplane flying at a great altitude. It is conceivable that friendly aircraft might be bombarded and hostile machines allowed to escape. The sky is usually so luminous that a flying machine appears silhouetted against it. Hence the device, used in the Balkans, of painting the outer ends of Greek biplane wings and the vertical rudder with the national colors, blue and white, was not very successful. Whatever identifying marks a machine may carry, must be large. Flags flown horizontally might answer, but even these, at great altitudes, must appear merely as appendages. Besides, if they are not to impede the machine, they must be very light. At great altitudes the nationality of an aeroplane might be recognized not by the colors of its flag but by its distinctive design. In Morocco and in the Balkans the problem of distinguishing friend from foe in the air did not arise, simply because in both campaigns the use of aircraft was rather one-sided. The doubt whether a machine is a friend or not may cause the forces on the ground to lose the few fleeting moments during which they have a chance of bringing down an air scout. Moreover, there are at present too many types. The same service types are to be found in several armies. Hence, it would be difficult, if not impossible, to recognize the nationality of a flying machine from its build, as sailors recognize a ship by the cut of her jib. It is far easier to identify airships chiefly because of their size. There is no possibility of mistaking a German Zeppelin for any other type of craft. With the Parseval the task is perhaps more difficult, all the more so since several European armies are equipped with vessels of the Parseval type. The German "M" type is easily recognized, and so is the French Lebaudy.

### New Safety Device for Spinning Sheet Metal

IN the ordinary process of shaping or spinning sheet metal objects on the lathe, the shaping tool is held in the hands of the workman who, by his own muscular power, presses the tool firmly upon the work and against a support. In shaping large lamp reflectors and similar objects in this manner, from thick disks of iron, brass or copper, the muscular effort required is so great that the workman must be strapped to the lathe. The work is very fatiguing and often causes chronic diseases of the liver and other organs, in addition to injuries to the left hand, which the workman uses to hold a guide against the rim of the rotating disk to prevent excessive vibration. Articles that have bulged cannot be worked into shape because of the danger of the operation. The process is also very slow and requires great skill.

Hermann Rahn, a master mechanic of Berlin, has patented an apparatus free from the defects and dangers mentioned above. The essential feature of the device, as shown in the accompanying illustrations, is a pair of levers. One of these levers serves as a guide and a support for the tool to which it is attached, while the requisite pressure is applied by means of the second lever which can be operated independently of the first. In order to enable one operator to carry on the entire process alone, the rim of the rotating object is guided by a roller and spring or some similar device, so that the left hand of the operator is left free to work the pressure lever.

In the simplest form of the apparatus the pressure lever is mounted on a pivot attached to the frame of the lathe, while the tool lever is connected with the pressure lever by a universal joint, and can therefore be moved freely in any direction. In a more complex form, adapted for a greater variety of work, the pressure lever is screwed into one of a series of holes in the periphery of a disk which is mounted eccentrically on a fixed pivot, while the pivot of the tool lever is inserted in one of a series of holes in the face of the disk at varying distances from the center. By this arrangement the leverage and the pressure can be varied without affecting the guiding of the tool, which is free to be moved in any direction desired. Other variations in the form of the apparatus are also available, but the principle remains the same.

Efficient operation of the Rahn spinning apparatus is so easily acquired that an unskilled workman, after two or three days of practice, can turn out more work than can be accomplished in the old way by a skilled workman who has had years of practice. Furthermore, it is possible to work sheets of twice the maximum thickness used in the old process, and yet no straps or other devices need be used to increase the pressure. The average waste produced by unskilled workmen in the improved process is said not to exceed two pieces per thousand, while heretofore the most skilled operators have counted on a waste of from ten to twenty pieces per hundred. One of the greatest advantages in the new process, however, is the freedom from accident and diseases to which the operators are constantly exposed by the old method.

### Variable Speed Hydraulic Transmission for Motor Trucks

ONE of the most essential elements of the motor vehicle is the transmission system, for if this important part is not properly designed no end of trouble will result. The type of transmission most generally in use in both pleasure cars and motor trucks is the change gear set using spur gears. Of late years, however, the designer has been turning his attention to the development of other types of transmissions with the object of overcoming the inherent disadvantages of the prevailing spur gear.

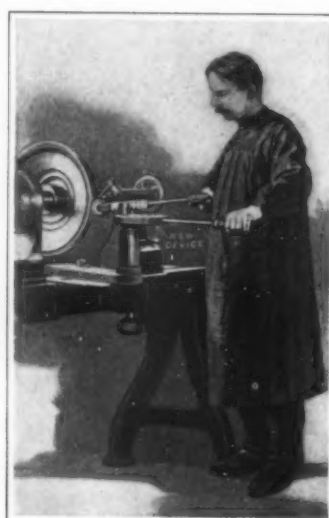
Although the variable speed hydraulic transmission, illustrated herewith, is not entirely new in principle, it has been reduced in size and simplified in design for application to the motor truck. This transmission system consists of a reciprocating, multi-cylinder, rotating, single acting pump and two motors of much the same construction and operation. The pump is direct connected with the engine shaft, while one motor is connected with each jack shaft. The pump and two motors are encased in an oil-tight, cast-iron housing as shown herewith. The working medium, by which the motors

are actuated by the pump, is a medium heavy machine oil. Besides the mechanical advantages of the hydraulic transmission system there is the added advantage of constant lubrication of all moving parts.

As shown in the engraving, the main axis of the pump barrel *B* is in the same line with the axis of the driving engine shaft *A*, while the axis of each motor cylinder *C*, stands at an angle of 45 degrees with that of its corresponding jack shaft *D*. The driving head *E*, which holds the piston rods, is rotated by means of a plate *F* keyed to the shaft of the engine. This plate is notched around its periphery to receive the piston rods. The pump driving head *E* is so constructed that



Old method of spinning sheet metal. The operator must use the strap in order to obtain the necessary pressure.

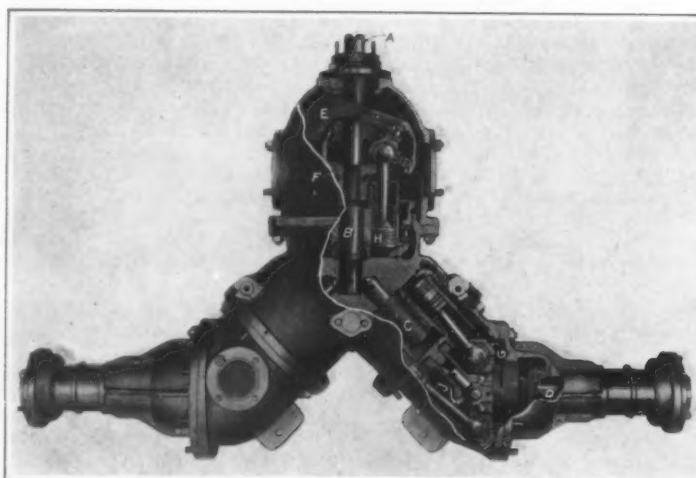


New method of shaping sheet metal objects by means of the Rahn lever apparatus. It can be done by an unskilled workman.

it rotates about an axis at an angle of 20 degrees, either side of the normal, with the axis of the driving shaft. This gives the driving head a total movement of 40 degrees.

On the other hand each motor drive head *G* is fastened to its corresponding jack shaft *D*. The full stroke of the pump pistons *H* is shorter than the stroke of the motor pistons, and by regulating the angle of the driving head *E*, which is done by means of a hand lever in the operator's compartment, the pump stroke may be varied from zero to full stroke, while the stroke of the motors remains fixed. The pump cylinder barrel is keyed to the engine shaft, while that of each motor rotates on a fixed spindle, and is connected by means of a bevel gear *J*, to the jack shaft *D*.

Speed variation may be obtained in two ways, each



The new hydraulic transmission with section of casing cut away to show construction of oil pump and motor.

method being independent of the other, while both are capable of simultaneous action. First, with the engine running at a constant speed, the speed of the vehicle may be varied from full reverse, through zero or neutral, to full speed ahead by changing the angle of the pump head *E*, by means of the hand lever, as explained above. This varies the stroke of the pump pistons, thus regulating the cylinder displacement. Second, the speed of the vehicle may be varied by maintaining the pump in any desired position and operating the fuel lever to regulate the quality of the explosive mixture passing to the engine cylinders.

The peculiar combination of the hydraulic pump and

motors gives somewhat the same action as a universal joint, inasmuch as it provides a positive connection and rotation between two shafts operating at an angle with each other. Since the working fluid is practically incompressible, it forms as positive a link between the engine shaft and the driving wheels of the vehicles as does the usual bevel gear differential.

One of the principal advantages of this system is that it entirely eliminates the necessity of a clutch with its attending weight and frequent trouble. Also, since braking may be accomplished by operating the speed lever, the necessity of two sets of friction brakes is obviated. Throwing the lever to zero or neutral, locks the vehicle against forward or backward travel. Herewith the complete system is shown installed in a motor truck chassis. It will be noted that with this transmission the chassis is remarkably free from all mechanism incident to clutches, differentials, brakes, and spur gear systems.

Although the pressure on the working fluid varies with the amount of power transmitted, and may reach 1,000 pounds per square inch under heavy service, the pressure may be reduced by increasing the size of the transmission system.

### Action of Ultra-violet Light on Animal Organisms

GREEN plants are known to thrive particularly in red light which is absorbed by their chlorophyll, and water plants often adapt themselves to the greenish-blue light they receive, by assuming a red or yellow coloration. Blue and ultra-violet light does not exert a favorable action on green plants, while bacteria are injured and, in the event of a prolonged action, killed by these light rays (disinfecting power of light).

Many inferior animals perceive ultra-violet light directly, being often disagreeably affected by it; ants, e. g., are known to carry their pupae from the light visible to man into the dark and to shun even the ultra-violet rays invisible to us.

Mammals do not seem to perceive as light rays of any greater spectral range than man. Heat rays exert on the skin and mucous membranes effects different from light rays, the action of which lasts longer and may result in inflammations as well as excite the formation of pigments.

In view of the conflicting views recently enunciated as to the action of ultra-violet rays on the retina and other media of the eye, Dr. Spuler, in a paper recently read before the Karlsruhe Scientific Society, considers the action of these rays on the animal organism. Apart from the solar spectrum, he examines with a quartz spectrograph the various sources of light in common use, ascertaining the absorption of various glasses as well as the refractive media of the eye. Open arc and quartz mercury lamps were found, apart from the sun, to be the only sources of light giving out ultra-violet rays in any appreciable amounts. An ordinary thin glass plate will absorb a great part of the rays emanating from the sun, to which all those living much in the open air, are exposed; such persons, however, are known just to possess especially good eyes.

On the other hand, it should be remembered that any strong source of light reduced more or less to a single point will cause glare in the visible part of the spectrum, against which any glass affords some protection by absorbing part of these rays. The task of illuminating engineers therefore consists in providing a light similar to diffuse daylight such as (apart from the distribution of energy) is to be found in indirect lighting.

### Two New Foreign Institutes of Science.

—The executive committee of the German Society for the Encouragement of Science and Industry, known as the Kaiser Wilhelm Gesellschaft, has recently decided to found a Hydrodynamic and Aerodynamic Institute at the Göttingen University. It will be in charge of Prof. Ludwig Prandtl. At the last meeting of the committee, held on June 17th and presided over by Prof. Harnack, Prof. Emil Fischer was elected vice-president in the place of Prof. Ludwig Delbrück, recently deceased. We also note that the Coal Institute, founded at Mulheim, will be opened on April 1st, 1914. Its annual budget will be 120,000 marks, of which 100,000 marks are contributed by industries established in the region of the Rhine River.

# How Mexican Rebels Destroy Railways and Bridges

By G. E. Weeks



Track pulled loose, wreckers piling up ties preparatory to burning.

THE deliberate destruction of railroad tracks and costly steel bridges is a thing not often seen, but since the beginning of the Madero revolution in Mexico in 1910 such destruction of valuable property has been one of the favorite methods of warfare in that country adopted by those opposed to the existing government. This is due not alone to the desire to prevent the use of the roads for the transportation of troops and supplies, but also to the fact that the lines chosen for destruction are the property of the national government, or at all events a majority of the stock in those lines is the property of the nation. This is true of fully three fourths of the railroads in the Republic.

Many hundreds of miles of track have been destroyed, hundreds of bridges, many of them expensive steel structures, have been burned or dynamited, and it is said that over fifty per cent of the rolling stock of the national lines has also been wrecked, burned or otherwise put out of commission.

After Madero triumphed some effort was made to restore the destroyed lines and bridges, but rebel bands in various portions of the country made this a difficult task, and when in February last he was deposed and assassinated, there was a very large mileage which was still in need of restoration. As soon as Huerta assumed power, the Maderistas—now termed by themselves Constitutionalist, but by their enemies called rebels—at once began destroying the railroads by which Federal troops could be moved against them, and at the present time there is a larger mileage of track out of commission than at any time during all the troubles of the past two and a half or three years.

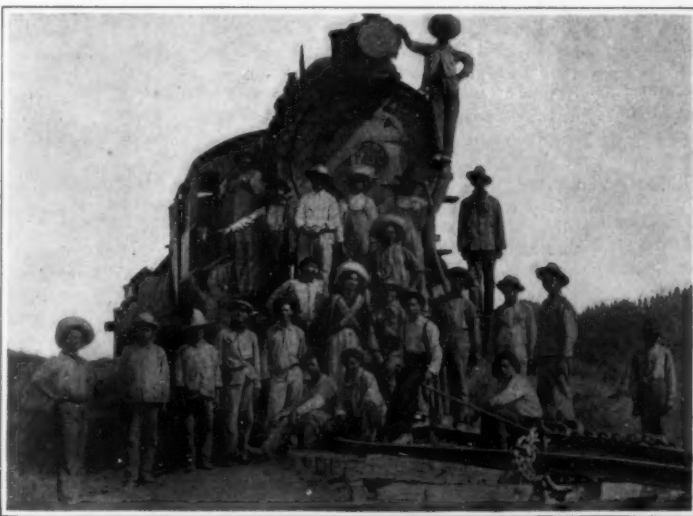
On a recent occasion the writer had the privilege accorded him by the Constitutionalist leaders of visiting a point in the State of Coahuila, where track and bridge destruction was in full progress, and a most interesting sight it was. He was also permitted to carry a camera and take views of the work of ruin, some of which are given herewith. Up to the past six months track destruction had been accomplished either by the use of a wrecking crane, which lifted sections of rails and



This woman soldier travels on the train with the other guards.



Engine backing up and tearing loose the track and ties.



This shows how the 220-ton engine is shackled to the track, preparatory to pulling.

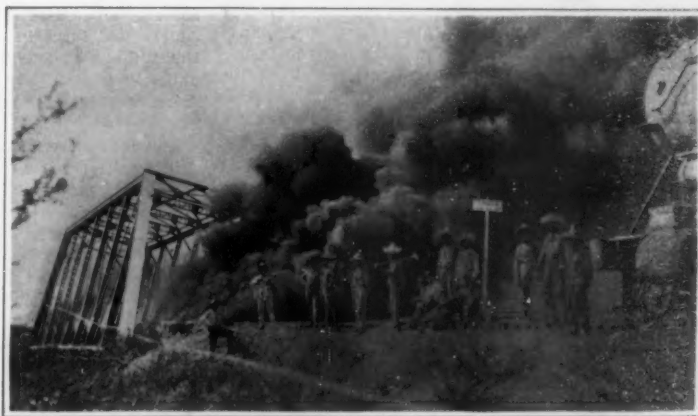
ties bodily and piled them up ready for burning, or by the slower process of the claw-bar, wrench and pick. But a Constitutionalist expert devised a new system, which is shown in the accompanying photos, taken "on the spot" by the writer.

A trench is dug between two ties, through which a heavy chain is passed around two opposite rails and made fast in the center of the track. To this one end of a heavy steel cable is hooked, the other end being made fast to the coupling on the engine pilot. At the signal the engineer starts his locomotives slowly backward, and as they are huge 220-ton "consolidations," with 22-inch by 30-inch cylinders, one can readily imagine that something has to give. And it does! The rails are torn loose from the spikes that hold them to the ties and are dragged closely together in the center of the road-bed. The ties are loosened from the ballast and dragged into piles, while in many cases the rails are badly bent and twisted by the force applied. A gang of men follows the engine, piling ties on top of the rails and leaving others beneath them. These are then saturated with oil and a match applied. In a short time the ties are consumed and the rails left lying on the ground twisted and contorted into all sorts of shapes, and of no further use until they have been re-rolled.

An interesting feature to railroad men was noted in connection with the resistance offered by the fish and tie plates to the work of destruction. Where the old-fashioned fish plate was used, a single pull often destroys from two to three kilometers of track before any resistance sufficient to break the chain is encountered. In this way as high as twenty kilometers of track have been torn up and burned in a single day. But where the Goldie tie plates are used, as was the case with the track the writer saw destroyed, not more than one hundred to two hundred feet could be torn up at a time, the chain usually breaking in less than that distance owing to the immensely superior resisting quality of the tie-plate named. No better test of the comparative merits of the two methods of rail connection could be devised. The rails on this por-



The 800-foot bridge at Sabinas, mined in readiness for dynamiting.



Bridge at Obeyes burning after having been dynamited.

RAILROAD WRECKING IN MEXICO.

tion of the track were 85 pounds in weight and are stamped "Carnegie."

The destruction of wooden bridges, of which hundreds have been ruined, is of course easy. They are simply saturated with oil and burned. With the steel bridges, however, it is different. These are destroyed by drilling holes into the piers and abutments close to the bridge seats, as also rows of holes horizontally along the bottoms of the piers where they can be reached, according to the state of the water in the stream. These holes are charged with dynamite, the fuses are connected with a battery of the type used in the coal mines in this region, and when the opportune moment arrives the electric current is turned on and the bridge is usually pretty effectually ruined. The accompanying photo shows a truss bridge at Obeyes, Coahuila, on the line of the old Mexican International Railway, which was destroyed while the writer was at the place. This was merely displaced with dynamite and the woodwork burned. The solid steel girder bridge, five spans, over the Hermanas River, was destroyed a few days before the Obeyes bridge, but it is so far within the enemy's lines that no photo is available. The solid stone masonry piers and abutments were completely destroyed, according to eye-witnesses, leaving the girders bent and twisted at the bottom of the stream. The photo of the Sabinas bridge, also given, is that of one of the largest and most costly railroad bridges in northern Mexico. It consists of ten spans of solid steel girders, each 81.6 feet in length, carried on piers and abutments thirty feet above the water. This structure lies directly in the line of the advance of the Federals, and it has been prepared for instant destruction in the same manner as other bridges farther down the line.

It will cost the national lines of Mexico many millions of dollars to replace their destroyed rolling stock, bridges, stations, etc., and this promises to cause them great financial embarrassment, if not bankruptcy, which at this time seems imminent. It will take years to put these roads in the same good condition which prevailed at the time Madero began his rebellion against President Diaz.

Piedras Negras, Coahuila, Mexico, August 29th, 1913.

### The Necessity of Accurate Railway Track Scales

WITH an almost unending discussion of railway freight rates, it is somewhat strange that tardy recognition has just been given by the Interstate Commerce Commission to an equally important factor in the problem. Prices and rates for commodities and their transportation are but one element in the equation of cost, for it is also essential to consider quantities. Where the total amount of the changes is determined, not by numerical count of articles or packages, but by weighing, then the consumer or shipper is as much interested in the correctness of weight as in the selling price or the rate charged for its transportation. In other words, an error of ten per cent in the scales is quite as important as an overcharge or rate ten per cent in excess of the proper figure. Indeed, it would seem most obvious that with a business undertaking so highly organized as an American railway, freight should be weighed with the highest possible degree of accuracy.

Unfortunately such is not the case. We learn from a recent investigation by the Interstate Commerce Commission that three fourths of all the track scales in use in the United States are of defective design or improperly installed; that less than one fourth are properly inspected; that hardly ten per cent are properly tested, not to speak of the great majority not being tested in any proper sense at all; and that nearly everywhere methods of weighing are unsatisfactory and careless.

This was the condition when the Interstate Commerce Commission began its investigation in 1912, and such is the condition in large part to-day, though many of the railways have realized their deficiencies and have undertaken reforms. A few lines like the Pennsylvania, Santa Fé, and New York Central, which have paid some attention to track scale inspection for several years, have introduced improvements in design, inspection and operation, organizing this work with technically trained inspectors. As most freight charges are computed on carload lots by weight, usually assessed by the hundredweight, it can be seen how important this matter is; for erroneous weights affect both the shipper and the earnings of the railway. Many railway officials claim that errors are as often in favor of the shipper as against him and that overcharges at one point due to inaccurate weighing are counterbalanced by undercharges at another point of which no complaint is heard. Such an answer obviously is quite unworthy of serious consideration either as a defense of present practices or as an excuse for not changing methods.

In Minnesota and Oregon the inspection of track scales is undertaken by the State Departments of Weights and Measures, and last January a bill with a

similar object was introduced into the Senate of the State of New York. In southern and western States shippers have formed weighing and inspection bureaus to secure protection and advantages, but so far as the railways themselves are concerned, outside of a few lines conditions are generally quite bad, and there is great lack of uniformity. In some cases cars are weighed coupled at both ends, then coupled at one end, and then quite independently. Cars are weighed in motion as well as at rest. Mechanical and automatic recording devices are used in some cases. Not infrequently weighmasters are careless and incompetent. The tare weights stenciled on the cars it was found are in error in practically 80 per cent of American freight cars, and of 10,967 cars the figures were actually weighed correct in but 506 instances, and that the error, which averaged about 500 pounds, ran up to 6,000 and 9,000 pounds in some cases.

While much can be done by the railways, the shippers and by local authorities, yet the Interstate Commerce Commission believes that some Federal commission, possibly the Interstate Commerce Commission, should be given authority to fix the points at which track scales should be installed, to prescribe standards of construction, to test or supervise the testing, and finally to supervise operation. Failing proper local action this would be eminently desirable, but in the meantime much can be expected from what a number of the railways are doing to improve this department.

### The Military Value of Low Flying

By C. Dienstbach

THE real danger zone for military aeroplanes in time of war lies at moderate heights. At great altitudes (4,000 feet and more) flying is reasonably safe. A second zone of safety lies next to the ground; there, because a speedy aeroplane is most elusive and cannot be so easily hit as may be supposed. Spectators at flying machine meets know how difficult it is to see a machine near the ground after the head has been turned for a moment. To a low-flying machine covers are as useful as they are to cavalry. But at a moderate height an aeroplane can easily be tracked on its whole course. Indeed, it draws the fire of massed infantry and artillery, consequently of a numerous percentage of highly skilled marksmen. Low flying, too, removes the serious difficulty of losing one's way, which often happens at high altitudes.

Because the aeroplane is not safe at these intermediate elevations, it follows that it must be able to change its altitude very quickly and easily. Safety will probably lie in flying low until a safe distance is reached, whereupon an ascent may be attempted. With the attainment of automatic or semi-automatic stability in the near future it may confidently be expected that the aeroplane will become a practical, low-flying vehicle for war purposes at least. The aeroplane will then be like an automobile running on an ideal road which leads everywhere; or like a troop of cavalry which can gallop on untiring mounts across rivers, fences, ditches, trees, with three times the speed of the finest race-horse.

The low-flying aeroplane is concealed not only behind hills, woods, and villages, but also in front of them. The sky is the worst possible background for aircraft, simply because all objects are silhouetted against it. On his flight from Albany to New York for the Hudson-Fulton trophy in 1910, Curtiss was completely lost from sight while flying below the top of the Palisades.

Bomb-dropping obviously becomes more effective the lower the altitude of the machine. A squadron of aeroplanes flying very low, could suddenly attack a fighting front from the flank and drop bomb after bomb while rushing along the entire line. Each machine would merely drop bombs in its tracks. A miss would be difficult. To be sure, a certain distance would necessarily separate a leading from a following machine, not only because of the explosives, but because of the danger that lurks in the invisible wash of propellers. Under the same condition machine-gun fire would probably prove even more efficient, because lighter, and therefore a greater quantity of ammunition could be carried.

But before the low-flying aeroplane can really perform the function for which it is manifestly destined it must be protected. The vitals of an aeroplane are much smaller in volume than those of a horse. Hence they can be even more easily protected by armor without cutting down speed or mobility than were the chargers of medieval knights. Already the military nations of the world demand protected machines. In the war of the future we may therefore expect to see steering gears, motors, and men all incased in bullet-proof steel sheeting.

### The Two-speed Rear Axle

IN the SCIENTIFIC AMERICAN for August 2nd, in an article on a new two-speed rear axle, it was stated that "the car will travel nine miles farther on a given

amount of fuel with the high gear in use than it will with the low gear in use." Manifestly, this is incorrect, and the statement should have been: The car will travel nine miles farther on a given number of engine revolutions (700 revolutions a minute for instance) with the high gear in use than it will with the low gear in use.

### Triumphs in Surgery

THE International Congress of Medicine, recently held in London, brought many remarkable contributions. We reproduce here from the *London Times* (Weekly Edition) brief notes on two or three of the most startling new advances placed on record.

#### Removal of a Lung.

The Section of Surgery discussed a new branch of surgery, "Intra-thoracic Surgery."

Sir William MacEwen's contribution to the debate was by far the most interesting and informing of the day. He drew attention to two points in that large subject. In the first place, he wished to demonstrate a patient operated on by him 18 years ago, whose left lung had been removed in its entirety for tubercular disease. The patient had been brought from Glasgow and was seen by the section to be a strong, healthy-looking man whose left side was hollow and fallen in. He was engaged steadily at work. At the time of the operation the right lung was diseased, but the removal of the hopelessly diseased lung was followed by improvement in the condition of the remaining lung.

That experience had been found in four other similar cases. In all these cases the apex of the diseased lung had been adherent to the great vein at the root of the neck, and at a later stage in the last four cases the vein and that piece of lung were removed. In the first case the patient for some days suffered great distress from the "flopping" of his heart to and fro as his position was changed. This symptom was obviated by stitching the pericardium to the front part of the chest wall.

#### An Artificial Kidney.

A demonstration which excited great interest was that of Prof. Abel of Baltimore.

Prof. Abel presented a new and ingenious method of removing substances from the circulating blood, which can hardly fail to be of benefit in the study of some of the most complex problems. By means of a glass tube tied into a main artery of an anesthetized animal the blood is conducted through numerous celloidin tubes before being returned to the veins through a second glass tube. The celloidin tubes are immersed in saline solution. All diffusible substances circulating in the blood pass through the intervening layer of celloidin, and can be found in the saline solution, where they can be subjected to fractional analysis. In this way Prof. Abel has constructed what is practically an artificial kidney. In many instances the working of the added excretory organ is more rapid than that of the actual kidney of the animal; 3 per cent per hour of salicylic acid can be removed from the blood. Although primarily the apparatus is of use in the estimation and analysis of the diffusible contents of the blood, it is possible that the principle may ultimately be adopted in the treatment of disease. At the close of the demonstration, which excited the liveliest interest and discussion, Prof. Abel was accorded round after round of applause.

#### Transplantation of the Kidney.

Dr. Ernst Jeger demonstrated a number of specimens to show what had been achieved experimentally in dogs. He had successfully removed a piece of artery and stitched in its place a piece of vein taken from the same animal. He had transplanted one kidney of a dog from its abdominal position to the neck, joining the renal artery to the carotid artery, the renal vein to the jugular vein, and the function of that kidney was continued unimpaired.

### Prototype of the Yale Lock

OUR attention has been called to the fact that in a contributed article in the SCIENTIFIC AMERICAN for August 16th, 1913, on page 125, entitled "Prototype of the Yale Lock," the word "Yale" is possibly used in a descriptive sense, referring to the particular type of lock. Of course, if the word is so understood in the article such use is inaccurate. The word "Yale" in connection with locks has been for many years the recognized and established trade mark of the Yale & Towne Manufacturing Company, and is used to designate not only any type of lock, but any lock of any type made by that Company, and locks of every type, including lever tumbler locks, combination locks, or warded locks, would be as appropriately referred to as "Yale Locks" as the cylinder lock illustrated, and in the article referred to the word "Yale" was used because of the great popularity of the cylinder locks made by that company, so that colloquially the word "Yale" is somewhat incorrectly used in that sense.

## Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

### Wanted: A Humane Animal Trap

To the Editor of the SCIENTIFIC AMERICAN:

The Massachusetts Society for the Prevention of Cruelty to Animals, Boston, has just published a pamphlet setting forth in text and illustrations the cruelties of trapping wild animals, such as foxes, etc., for their fur, by means of the old-fashioned steel trap, and the inhumanity of the thing is so vividly portrayed by both pen and picture, that I appeal to the ingenious readers of your extensively circulated paper to put their minds to work to devise a humane method of catching these animals, if they must be caught, and to put an end to the horrible torture-dealing steel trap of the centuries. To better understand the subject, I would suggest that your readers write the above-named society for a copy of the pamphlet, which will be sent free of charge, so that they may see and understand from the illustrations what furs cost in torture of wild animals, which have the same right to a painless and merciful death that our domestic animals have. There is a great opportunity for some reader of the SCIENTIFIC AMERICAN to not only win for himself the thanks and the gratitude of humane people the world over, but also a more substantial reward in dollars and cents, by inventing a humane method of capturing these animals without first "crucifying" them.

Brooklyn, N. Y.

GEORGE FOSTER HOWELL.

### The Maximum Parcel Post Package

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Taylor's communication, published in your number of July 19th, page 51, on "The Maximum Parcel," is very interesting and highly ingenious. Allow me to observe, however, that no person has any serious doubts as to what is meant by length, although some may evidently differ as to the proper wording of a definition for the term.

The definition of length as "the greatest distance in a straight line between the two ends of the parcel" is not as faulty as Mr. Taylor makes it appear. The ends of my rectangular receptacle, for instance, are two parallel planes and these are equidistant at all points, so that distance between the "two ends" cannot mean distance between two of the "eight corners," selected so as to measure at an inclination to the "length" dimension of the package.

The obvious reason for saying "greatest distance in a straight line" is to cover irregular packages, having no well defined dimensions, and to prevent too long a measurement by bending of the string or tape.

As I construe the rules of measurement, the length of a parcel, however irregular such parcel may be, is equal to "the length of the smallest circumscribed rectangular parallelepipedon," but this would be a dangerous definition to use as some of our well fed country postmasters are subject to apoplexy, and you will find that it is difficult to say the equivalent of this school room definition in a few simple words.

Arlington, Va.

JOSEPH BECKER.

### Progress in Air Navigation

To the Editor of the SCIENTIFIC AMERICAN:

Several recent visits to Hempstead Plains have confirmed a previous feeling of disappointment, that the art of flying is still in the amateur, or bicycle stage. The automobile stage or practical application of the great discovery seems not only not in sight, but not even suggested.

Langley's experiments (Smithsonian contributions, 1891-1893), showed that he had solved the problem except for three elements, all of which have since been supplied. First, a lighter and more powerful engine. Second, a method of safely leaving the ground and alighting. Third, a method of controlling the course of the aeroplane. (See Hiram Maxim, *Century Magazine*, January, 1895).

Three things strike the observer, on examining the latest machines now shown to the public.

1. Starting the engines by twirling the propellers. This certainly seems primitive. Imagine it done under fire in warfare!

2. The fastening of the wings by wires, wire cords, and flat strips of steel. These are fastened often by simply twisting through eyelets, or over pins, sometimes slightly soldered. Many of the recent fatal accidents are reported as caused by the collapse of a plane. When it is considered how the entire equilibrium depends on a few wire braces, the trivial way in which these are fastened and made taut, explains, to my mind, the ominous death list.

3. The starting over rough ground must set up a strain on the wires and fastenings. It seems the extreme

of careless management to subject all these slight bits of steel to the jarring and jolting caused by the great leverage of the long outlying planes and ailerons. A large space like a dance hall could be planked over, and the start and landing made with much greater smoothness.

The wonderful ease and grace of the planes, once in the air; the speed, guidance and control; the floating and gliding return to the ground; all these prove that the main difficulties were solved two or three years ago. Since that time, there has been little gain, as far as can be seen, in the directions of wider use or greater safety.

A model was shown last winter, in a Broadway window, of a platform hung beneath an extended plane, bringing the center of gravity lower. It would apparently hold a crew of eight or ten. The prospectus stated that it would come to the ground in safety, on the parachute principle, if the engines become disabled. Here is a suggestion of development which seems on right lines; as superior to the machines at Hempstead as the autobus is to the motor cycle.

J. D. HOLMES.

New York city.

[The progress that has been made in aerodynamics during the last two years has not been journalistically sensational. Hence, is not so widely known as it ought to be. Engine powers on the whole have been reduced and speeds have increased, proof enough that the problem of air resistance and of securing streamline forms has not been neglected. Eiffel's experiments, painstakingly conducted, for many years, but unheralded in the daily press, have disproved much of what was regarded as aeroplane gospel three years ago, and have enabled aeroplane designers to work more intelligently. Even some of Langley's work may be regarded as superseded by that of Eiffel.

As for the minor points to which our correspondent calls attention, we might mention that more or less successful attempts have already been made to start aeroplane engines with cranks; that the wire fastening of the wings is not regarded by designers as the best method of stiffening a wing; and that some designers, notably Gallaudet, have very ably solved the problem of holding wings by other means.

The difficulty of starting over rough ground is not likely to be overcome by the means proposed. If a large space "like a dance hall," carefully planked over, is to be the chief reliance of the aeroplane in starting, why not recur at once to the old Wright starting rail, which is much simpler and cheaper? The truth is that an aeroplane must be designed to withstand the racking strains set up by bowling over rough ground at high speed. Dance hall platforms could never be ubiquitous. Indeed, the French military authorities realize this, and even require machines to run over freshly plowed fields and stubble. It is easier to adapt the machine to the ground than the ground to the machine.—EDITOR.]

### Teaching the Tropics How to Live

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of November 9th, 1912, of the SCIENTIFIC AMERICAN, we find a description in concise form of the application and maintenance of hygienic conditions in the Panama Canal district, to combat malaria, the greatest enemy of the white man in many tropical, sub-tropical, and some northern districts. But for these precautions and their results, it would have been far more difficult to achieve so great a success in such short time as was the case with the great Panama Canal.

The afore-mentioned article clearly shows that such measures involve an extremely large expenditure. The statistics were derived from results obtained with only a part of the workmen employed on the canal, as some men were not made subject to these measures and others were beyond control because they cured themselves when stricken.

The improved hygienic conditions tend to increase the number of working days, consequently a considerable sum of the working expense is saved, the wages being very high. The sum expended on hygiene will be covered by the extra labor gained and the resulting increased output.

Persons who have been employed in the tropics under quite different circumstances, for instance, in work on a smaller scale, with limited working capital, lower wages, and remote situation, are inclined to think that the costly method of conducting malaria hygiene is inapplicable in the vast majority of cases.

I therefore want to point out in this letter how, on the Guiana placer in Dutch Guiana, a notorious malaria district at 120 kilometers from the coast, a really good result was obtained with very simple means and little outlay, but without prophylactic medicaments. This result was accomplished with 12 to 18 Europeans of pure European descent, most of whom came directly from Europe. The state of health of colored and white men who suffered a great deal from malaria previous to their coming under the protection of these hygienic measures, was steadily improving, although recidivists were still

occasionally absent through illness, especially when the hot season had just set in.

For several years malaria has no longer been dreaded by Europeans on this placer, as there were no reports of absence through malaria in all this time.

A detailed description of these measures is contained in my book, "A Brief Outline of the Surinam Gold Industry, Geology, Technique, Hygiene," De Bussy, Amsterdam, 1911 (English edition).

It will suffice to state here that I started upon the principle that in a country where the hygienic conditions are entirely different from those of a civilized European country, the mode of living should likewise be altered altogether, and not in some details only.

The application and maintenance of hygienic conditions is not so difficult in itself, but the fact that it extends over a number of people, many of whom are careless by nature, does not facilitate matters. One has to exert will power, not only upon himself, but over others as well, and this in a popular manner.

For medical and practical reasons, chemical prophylaxis is not suitable for a prolonged residence. In this instance the so-called mechanical prophylaxis is applied, the results of which are pronounced to be ideal.

Our precautions did not extend beyond the actual dwelling place, because the surroundings were exceedingly unfavorable for malaria hygiene. Owing to numerous swamps (drowned forest ground) and work pits, drainage or constant supervision would either have become very expensive or would have been altogether insufficient. A removal of the whole body of workmen and their dwellings to a more favorable situation at Savannah, some 5 kilometers distant, would have been both expensive and impracticable, because of the great distance of the places where they have to work. Only the immediate vicinity was kept clean and in good condition.

The houses were built in such a way that they were permanently airy; the light could come in freely, and the whole building was kept practically anopheles free. Domestic work of any kind was done under gauze protection. The beds were provided with curtains of a special construction, which guaranteed the sleeper absolute safety from those anopheles which might accidentally have been indoors. The houses were connected with each other by means of a long passage, likewise provided with gauze.

Supper was taken at six o'clock instead of at half past seven. After sunset few wished to leave these airy homes, although a pleasant recreation hall within safe reach drew many of the people to intercourse on account of the billiard and reading tables. The work-place was lighted by strong lights in case of night work; the surroundings were cleaned, and rest was taken in anopheles-free apartments.

Another successful measure was based on the principle that the staff should have a certain interest in the strict upholding of the simple hygienic laws and the proper keeping of the hygienic arrangements. This was done by the superiors, who set the example by giving the staff instructions about the causes of illness and how to combat disease. Also a special wage system was introduced. This system was based on the principle that every good and careful workman is enabled to earn a very good wage, whereas in the case of malaria or sexual diseases the men had free nursing, but were paid only a small part of their ordinary wage; in the case of any other illness they received better pay. Then there was a premium paid for anopheles specimens caught indoors. The result was that everybody watched the results with the greatest interest and enthusiasm.

The cost of our malaria hygiene amounted to the sum paid in the shape of surplus wages and salaries—in reality nothing but a health premium—and the expenditure for the installation of the gauze walls, windows, and doors of the buildings. Medical attendance for malaria cost us next to nothing.

By laying down these rules, work on the Guiana placer was continued undisturbed. The adapted mode of living and the facts that the hygienic conditions and the diseases prevailing in the country are generally known, and that the whole of the staff was made responsible for the proper order of affairs on the placer, combined to create for our men more agreeable work, and the company reaped the benefits of steady, undisturbed work.

Amsterdam.

DR. J. H. VERLOOP.

**A Needed Plumbing Improvement.**—A plumbers' supply man tells us of difficulties experienced in the use of the flushometer valve employed in lieu of flushing tanks. One difficulty results from fluctuations of pressure in the water supply which naturally varies the amount of water discharged at each flushing. The problem is to provide some means to overcome or counteract the effects of variation of pressure in connection with the present type of flushometer valves; or to devise a type of flushometer valve that will not be influenced by the pressure fluctuating in the water supply, but will deliver the desired amount of water at each flushing operation, regardless of the service pipe pressure.

### Opening of the World's Greatest Power Plant Damming the Mississippi River to Produce 300,000 Hydro-electric Horse-power.

THE official opening of that vast engineering work at Keokuk, Iowa, owned by the Mississippi River Power Company, and popularly known as the Mississippi Dam, inaugurated the commercial service of the world's greatest hydro-electric power plant. The damming of the Mississippi at this point was made possible by the topography and geology at the site. The Des Moines Rapids above the dam present a fall of 23 feet in a stretch of twelve miles, and the bluffs of the river, at the rapids, are closer to the river than they are at any other point in its entire length; furthermore, they are close to the banks for most of the distance from Keokuk to Montrose. These conditions made it possible to construct a dam at the foot of the rapids which would cause a comparatively small area of overflow by the pool above—a most important consideration for the commercial success of the scheme. Furthermore, the bottom of the river at the site of the dam consists of a hard blue limestone, affording an excellent footing, judged from the engineering viewpoint, for the dam and other accessory work.

#### The Dam.

The great dam by which the water is maintained at the desired head for the development of the hydraulic power, is 42 feet 6 inches wide on the bed of the river and 29 feet wide at the top; it stands 53 feet in height above its foundations, and its length, including the abutments, is 4,649 feet. It is composed of 119 arched spans, measuring 30 feet in the clear, the piers being 6 feet thick. The spillway sections are formed of arches 30 feet long and 32 feet high, with steel gates mounted on top of the spillway, the gates being 11 feet high by 32 feet wide. The upstream face of the spillway dam as thus formed in the openings between the arches is vertical, the downstream face is formed in an ogee curve. The height of the water in the pond above the dam is regulated by the spillway gates.

#### The Power House.

At the western end of the dam and at right angles to the longitudinal axis of the same, is the vast power house, which extends down stream for a distance of 1,718 feet. The width of the building is 132 feet 10 inches, and its total height is 177 feet 6 inches. It contains four acres, on the first of which are placed the thirty 10,000 horse-power generators and their auxiliaries, and on the three floors above the oil switches and electrical accessories. The sub-structure, which is one vast monolithic mass, extends 70 feet from the limestone bed of the river to the generator floor. Within this mass are formed 30 vertical cylindrical chambers for the turbines, each with its conduits for the inflow of the water above and outlets for the exit of the water below. There are four circular intakes for each turbine. These converge into a scroll chamber, 39 feet in diameter, which is formed with a spiral floor, so shaped that the water impinges on every point of the circumference of the turbine with equal velocity and equal impulse. After the water has passed through the turbine, it emerges through a draught tube which is eighteen feet in diameter at the top, and at the bottom is oblong in shape, this portion measuring 22 feet 8 inches in vertical height, and 42 feet 2 inches in horizontal dimension. The bottom of the draught tubes and tail race is 25 feet below the bottom of the river.

#### The Turbines.

The turbines are of the general Francis type, modified and improved to suit the conditions. The normal capacity of each is 10,000 horse-power, and the overload capacity is 13,500 horse-power. At 57.7 revolutions per minute they have shown an efficiency of 86 per cent. This high efficiency is due, in part, to the construction of the intake and the spirally shaped scroll chamber. The old undershot waterwheel is driven by the water striking upon only a small part of its circle of blades. Even in the overshot waterwheel the energy of the water was applied to the buckets at only a small arc of the circle. The modern type, in which the whole circumference is available for the development of power, other things being equal, will give the largest output.

Because of the comparatively low head (the rating is based on a head of 32 feet), it was necessary to pass great quantities of water through the turbines to secure the required power—hence their great size and weight. The turbine, as will be seen from our front page engraving, is a huge casting. It is 16 feet 2 inches in diameter, weighs 73 tons, and carries twenty blades. It is placed at the bottom of the vertical cylindrical chamber prepared for it in the monolithic concrete of the foundation. This chamber is lined with a steel cylinder, and at the top and bottom are the upper and lower rings which support the entire weight of the power unit. Each liner weighs 212,000 pounds. The rings weigh 100,000 pounds each, and the weight of the turbine, its shaft, and the electric generator carried at the top of the shaft—that is to say the weight of the revolving parts of each unit is 275 tons. The whole



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General view of the Keokuk dam and power house for

of this weight is carried upon one bearing which, it can be well understood was made the subject of very careful design. The water is controlled and is guided to the waterwheel by vanes which turn upon vertical axes. These can be operated so that they completely shut off the water from the wheel, or they can open sufficiently to permit all the water to flow through. Their position is regulated by a governor acting through a system of levers which automatically controls the flow.

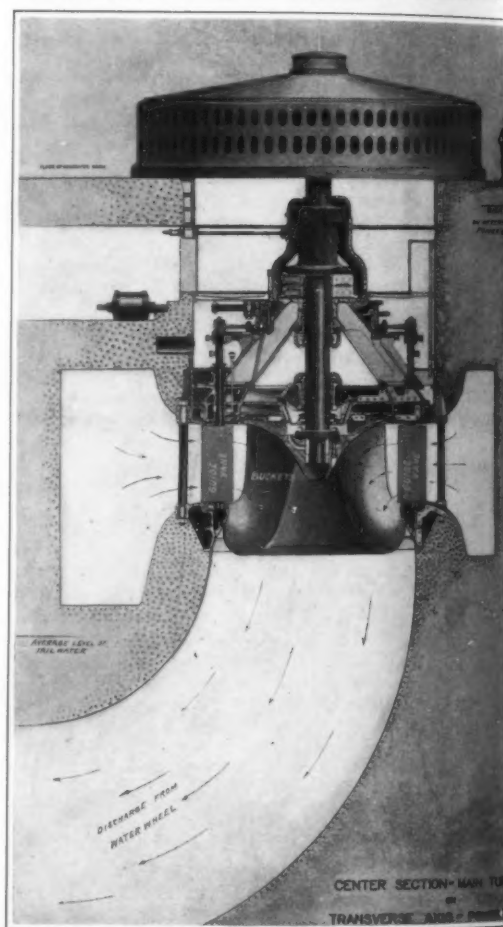
#### The Electric Generators.

At the upper end of the turbine spindles, at the level of the generator floor, are carried the generators, each of which has a capacity of 7,500 kilowatts. The current is alternating 3-phase 25-cycle, generated at 11,000 volts pressure. For local use of the current this voltage will be maintained, but for long-distance transmission it is stepped up by transformers to 110,000 volts. The diameter of the revolving field is 25 feet 5 inches, the outside diameter of each generator is 31 feet 5 inches, and the exterior height above the generator floors is 11 feet 3 inches. The efficiency is high, reaching 96 per cent.

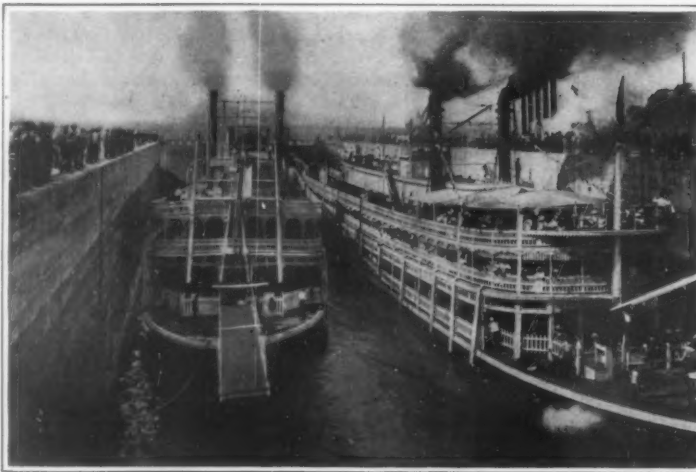
#### The Ice Fender, Sea Wall and Forebay.

Extending from the upper western corner of the power house, and swinging in an easy curve to the Iowa shore, is the ice fender, a concrete structure, 2,325 feet long, which is composed of 29 spans with 10-foot piers and 60-foot openings. It is 16 feet wide at the bottom, and 8 feet in width at the top. At its inshore end is a floating boom of heavy timbers which is 300 feet in length. The water flows into the forebay through the openings between the piers, and the ice and driftwood are stopped by the upper portion of the structure. During the navigation season the floating boom is swung back against the shore line, to permit the passage of boats. From the inshore end of the ice fender, down to the drydock, there has been built a massive sea wall, 45 to 73 feet in height, and 1,110 feet in length, whose function is to protect the adjacent tracks of the C. B. and Q. Railway. The power house, ice fender and sea-wall mark the boundaries of a large forebay, from which the water flows through inlets in the western wall of the power house for the operation of the turbines. At the downstream end of the forebay has been built a lock which is 110 feet wide, 490 feet long in the clear, and has a lift of 40 feet. The time of lockage is from ten to fifteen minutes; and boats passing through the locks between Keokuk and Montrose save two hours over the time occupied under previous conditions.

It is an interesting fact that most of the water-power devel-



Vertical section through one of the turbo-generator units showing transverse axis of power house.



Two largest Mississippi steamboats passing through the lock.



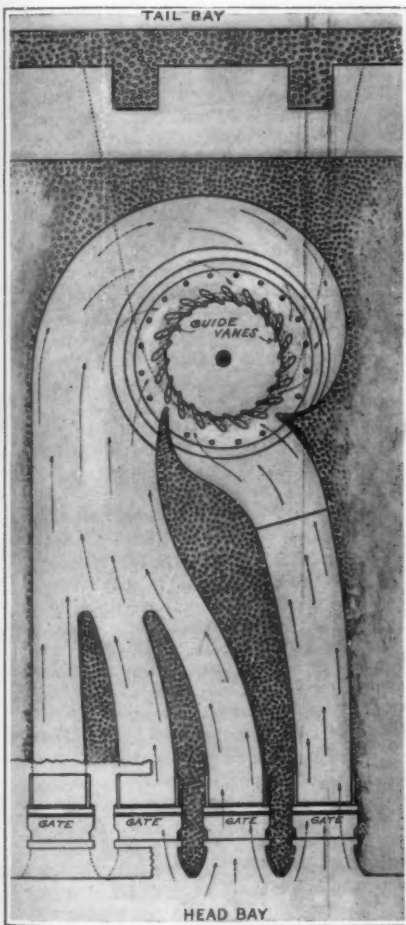
The long line of 10,000 horse-power turbines in the power house.



Power house for generating 300,000 horse-power by the Mississippi River.



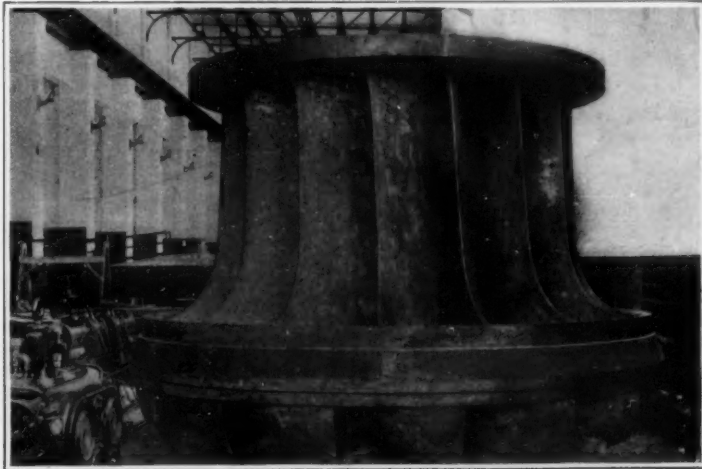
Generator units on the left side of the power house.



Horizontal section through an intake and scroll chamber.



Horse-power generators in the power house. Photograph by Auschuta.



Erecting one of the turbine wheels in the power house.

Development in the United States has taken place along the seaboard of the Pacific and the Atlantic. The Keokuk enterprise is the only development on a large scale in the heart of the United States. Its size and importance may be judged from the fact that its output will equal about half the total of all the five companies on Niagara on both sides of the international boundary. Practically all of the power will be available for manufacturing. By means of long distance transmission lines it will be available for light, power, traction purposes in the cities of the middle west over a radius of more than 100 miles. The plant was designed by Hugh L. Cooper, to whose ability, courage and business activities is due not only the design and erection of the plant, but the securing of the \$20,000,000 of capital necessary to put the enterprise through.

### An Encyclopaedia on the Card-index System

By Our Berlin Correspondent

THE amount of data constituting the sum total of human knowledge has during the last hundred years, grown at a truly marvelous rate: The scope of history has been extended over thousands of years, by archeological investigation of Egypt, Babylon, and Assyria, partly into the very details of daily life, while the local extent of historical research has been nearly doubled, the whole of Asia (India, China, Japan), America and Oceania, having been added, with their most ancient as well as recent history, inclusive of the political systems, languages, literatures, arts and folklore of their inhabitants. In the realm of natural science (zoology and botany), thousands of extinct species as revealed by paleontology, have been added to thousands of existing species, and the living organisms known to man have grown enormously through the addition, by the microscope, of further thousands of infinitely small beings, so far invisible. Nor has the number of physical phenomena daily brought to light or that of chemical facts with the increasing discoveries of new elements and combinations of old ones increased at a less stupendous rate. Progress has been made in all fields of human knowledge, and new sciences are fast springing up. The mass of our knowledge is weighing heavily upon us; accumulated facts are depriving us of air and light and hampering our free development. Because of the enormous amount of knowledge to be absorbed, the youth of our colleges is fast losing the faculty of utilizing the knowledge thus acquired. Nearly half the life is used up in getting ready for life. In a recent paper, Dr. M. Goldstein

suggests a principle which would seem alone to allow human knowledge to be classified for ready reference, thus doing away with any need for a sterile exertion of memory. The idea, in a sense, is already carried out in an American loose-leaf encyclopaedia, the publishers of which supply new pages to take the place of those that are obsolete. Dr. Goldstein's principle affords a means of recording all facts at present known as well as those to be discovered in future, with the same safety and ease as though they were registered in our memory, by providing a universal encyclopaedia, incessantly kept abreast of the state of human knowledge. Scientific education then would consist, in future, apart from imparting a knowledge of the outlines of a given science or doctrine, of teaching how to use this encyclopaedia and how to add to its treasures by personal work. It will be a question of understanding and knowing "how to do things," rather than knowing a mass of individual, often disconnected and useless facts.

Existing encyclopedias are evidently hampered by their bookish character, and are doomed to become antiquated by the time they are completed. The contents of a book are necessarily immovable and are thus in contradiction with life which is movable, in incessant flow. Books are well adapted for recording a finished system, exposing an established doctrine or literary work. In the case of a mere storehouse of facts, the infinitely more mobile form of the card index should however be adopted, possibly, we might add to the author's suggestion in conjunction with Dr. Goldschmidt's Microphotographic Library system.

A Bibliographic Center would have to be created which would be kept abreast of any variation in the actual status of human knowledge by permanent collaborators chosen among the competent representatives of each branch.

This Central Institute would have to prepare from the information thus received, periodical supplement and rectification cards to be sent out to subscribers at given intervals, in addition to or in the place of their old information cards.

This novel encyclopedia would, among other things, show the advantage of renewing itself periodically, like a human organism, and of never becoming antiquated. A glance at the newly-received index cards would keep individual investigators permanently abreast of all that is being done in their respective fields. The encyclopedia would serve on one hand as a reference work, enabling anybody to acquire the most exhaustive information desired on a given subject, more rapidly and completely than by means of any existing book. On the other hand, it would give of each science or doctrine in its whole or any of its parts, a systematic outline so that even those unacquainted with the leading facts might be able to obtain information.

The suggested encyclopedia would of course allow of any subdivision, so that only the large libraries and State Institutes would have to obtain the whole work, subscribing to the whole information service, individuals being content with the sections of special importance for their own needs.

### Military Aviation in Italy

WE learn that the Italian government has ordered 70 aeroplanes with a view of giving capital importance to this question. It is stated that all of these will be constructed in Italy, the greater part of branch works of the Nieuport, Blériot, Farman and Bristol firms. Of this last make there are about 30 machines ordered. A good number of the above machines are already in construction. The military commission received 14 aeroplanes not long since, and the coming army concourse is to furnish about 10 more. Counting all the above, the aeroplane fleet in Italy will soon be increased by 120 units, and at the same time the government is taking steps to secure all the power wagon and other material for making up the army aeroplane sections, each of which is to have 6 aeroplanes. No doubt the aeroplane sections or camps will be organized after the plan which proved so successful in France, that is each of the 6 aeroplanes has one power wagon to carry the material, stores and spare parts, and this tows a trailer van containing the aeroplane. Headed by the officer's car, this makes a traveling camp which is set up in the open air or travels over the road, accompanied also by special repair shop cars. Turin has been chosen as the leading aviation center, both for practical and scientific work, but the army also has large aerodromes at Mirafiori, Venaria Reale and St. Maurice. The Royal Industrial Museum has just organized a number of aviation laboratories which will be used for testing of motors, aerodynamic work and the like, and all the officers of the aeronautic corps will take part in these operations. Aeroplanes for the army are purchased out of the credit voted by Parliament or with the sums raised by national subscription, and the Aero Club of Italy has charge of some of these latter expenditures. On the whole it will be seen that aeroplane matters are very active in that country.

### Machine Cut Herring-Bone Gear

THE advance which has now been made in the way of producing double herring-bone gear wheels for all kinds of industrial use is well illustrated by the remarkable specimen presented herewith, and it is also an example of the way in which gear manufacturing is becoming specialized. The factory where the gear was made has gear-cutting machines installed for cutting herring-bone gears upon wheels up to 30 feet in diameter, and rolling mill pinions of as much as ten feet in length. Within a recent period the advantages of this class of gearing have become more and more appreciated, not only for use in rolling mills to transmit the large amount of power needed for the rolls and at the same time be able to stand the very severe shocks arising in this kind of work, but also in the navy and other fields where the use of electric motors is now becoming general. This kind of gearing is in fact well adapted to work in a number of cases where a large amount of power is to be taken from an electric motor. In view of the increasing demand for the gearing, the factory above referred to was erected in Paris exclusively for producing herring-bone gears, and owing to the specialization of this work, it is now turning out gears of high quality and precision. In consequence, the French navy is now making use of these gears largely. They are used upon a number of the battleships of the fleet for driving some of the machinery on board, for instance the "Paris," "Lorraine," "France" and others. They are also used on board four battleships of the "Verité" class and also on two cruisers for the machines of the rudders. For this same purpose they are now applied on submarines such as the "Emeraude" with great success. They are also employed in the Transvaal mines where 31 gear sets serve for electric winches of 250 to 900 horse-power, and 23 sets are used for tube mills.

### "Baboon Face"

THE photograph herewith reproduced shows a portion of a log of dogwood (*cornus florida*) which contains a peculiar growth. One might suppose that it represented a crude attempt at a carving of the face of an ape. But the specimen is a natural freak and is represented just as it grew on the tree; without the help of the tool. Such formations are not uncommon and are known by lumbermen as "baboon face." The particular specimen here shown is unusually striking. It was cut from a tree in Mississippi.

### Novel Colorado Hydroduct

THE accompanying illustration shows a novel sheet metal hydroduct over the main line of the Chicago, Burlington and Quincy Railroad, near Keensburg, Colo. The diameter of the flume is 7 feet and the height above the rail is 29 feet. Constructional details are shown in the line drawings which are longitudinal sections at a joint. The expansion joint used is as simple in construction as the regular wedged joint between sections. It has no rivets nor solder, is efficient, easily erected and requires no more room between stringers than that provided for the waterway.

The two meeting ends A and B are bent to form grooves which are nested one within the other. A bar C, shaped to fit the curve of the hydroduct, is recessed to receive the grooved ends A and B, then a wedge D also curved to fit the semi-circular hydroduct is driven into the groove fastening the ends A and B together providing a smooth floor for the water to flow over. The metal sheets are wedged and not simply "clamped" between the joint bars, and the weight of water carried by the metal sheets, is supported on each side of the joint by the wings of the bar C, to the point where the sheets are bent downward. The wings are sheared from each end of the bar C, leaving a round section which is threaded and when the nuts are drawn tight on each end, the wedge bar D is forced down



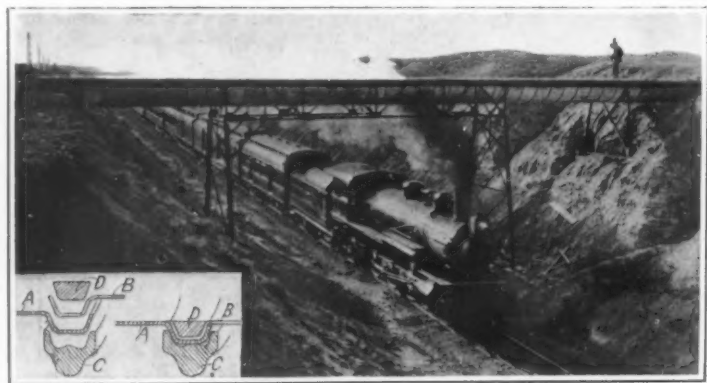
Enormous herring-bone gear.



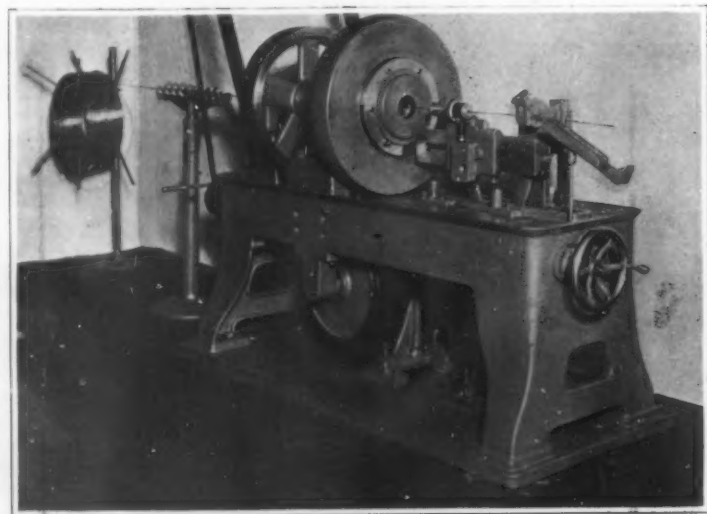
Sorting slabs according to gage.



A "baboon face" on a dogwood log.



Sheet metal hydroduct with simple wedged joints.



Machine for swaging automobile wire-wheel spokes.

into the grooves in the sheets or flume section, wedging the two sections between the wings of the bar C, and making a watertight joint.

### An Automatic Slab Gage

THE principal difficulty in connection with the use of slabs or plates (of wood, stoneware, clay, cement, etc.) for wainscoting, flooring, etc., is doubtless the sorting of the plates which, of course, cannot all be accurately of the same size. Especially in the case of burnt plates is there considerable uncertainty as to the eventual dimensions. This work, as generally done by skilled sorters, takes up much time, hence a machine has been brought out by a Leipzig engineer to perform the same operation automatically with higher accuracy and incomparably greater speed. It is based on a possible maximum difference of 1 centimeter (0.4 inch) between the dimensions of individual plates, and the plates may be sorted in eight different groups with individual differences of about 1 millimeter.

The apparatus is extremely simple in operation and can be handled by any unskilled workman and even by a child. The operator simply presses each plate or slab against the upright, thus setting the mechanism working. The upper edge of the plate, in fact, bears against a peg, thus lifting a slide which sets a crank disk moving. This crank disk in its turn displaces a stop more or less, in accordance with the displacement of the slide, and this indicates the amplitude of motion and accordingly the actual departure and thus the size of the plate. A printing style fitted with types is moved on more or less, in accordance with the deflection produced by the plate, and stamps the corresponding figure on the plate. This allows the sorting to be checked at any moment.

More than 10,000 plates can be sorted per day without any excessive strain. In order further to facilitate the work, the machine, unlike the arrangement represented in the accompanying figure, is mounted on a small rolling bench on which the workman travels along from heap to heap.

### Machine for Swaging Automobile Wire-wheel Spokes

A MACHINE that will take wire from the coil, straighten it, form it into spokes, swaging the spokes between butts and mechanically cutting them off to lengths after swaging, is depicted herewith. The coil is shown in the extreme left of the engraving, and passes through a straightener of the rotary wheel type. It has offset steel eyelets mounted with ball bearings in suitable holders and bearing yieldingly and revolvably against the passing wire so that there is no marring of the surface. The wire from the straightener enters the swaging machine through a hollow spindle fitted with dies. These dies close automatically over the wire after allowing the portion forming the butt to pass out of them, when they impart a number of sharp clean blows simultaneously from diametrically opposite directions reducing the stock rapidly and giving it a sort of "hammer temper." The dies then open again automatically, allowing the portion of wire forming the opposite butts to pass out of the machine unswaged. A saddle provided with a clutch is mounted on a horizontal slide in front of the machine head and draws the wire through. By means of an adjustable link the throw of the slide may be varied for spokes of different size. The wire-gripping chuck carried by the saddle, closes on the wire for the outward or drawing stroke and releases the wire at the end of the stroke, so that it can return to its starting position for drawing out the next spoke. In the meantime the wire is gripped firmly in the cutting out attachment, which consists of two hardened and ground steel bushings whose two cutting faces are in close contact and slide past each other, at the proper time, to cut off the swaged spoke with an almost perfect shear.

# Inventions New and Interesting

Simple Patent Law ; Patent Office News ; Notes on Trademarks

## Electrical Fire Protection

EACH advance in civilization brings to us new problems to solve, new obstacles to overcome and new dangers to face, and one of the most dreaded of these is the danger of fire.

The trend of growth of the modern city is vertical. Instead of extending over a greater area it is a practice to go to a greater height and depth, and therein our modern danger from fire becomes most imminent. The tendency of a flame is to rise, due to the air currents, and in providing suitable skyscrapers for our modern office buildings, and business establishments, we are at the same time constructing most susceptible fire-traps. Instances such as the recent Triangle shirt factory fire in New York city, bring this situation very forcibly to our notice. No complete solution has been found for the problem of fire risks, and the modern tendency has been to insure heavily and thus apportion the loss among a great number of people. But this matter of insurance, if closely analyzed, will show how preposterous it really is.

First of all, to insure a risk is to admit openly that due care and diligence cannot protect you. For instance, if your automobile had the common habit of running out of gasoline, you would not think of taking out insurance against this possibility. That would be the most open admission that you did not know how to meet the difficulty. No, you would proceed to fill the tank again whenever you found the supply was low. For after filling the tank it is quite obvious that some time will elapse before it is again necessary, but not so with the fire danger. It threatens every instant, and nothing at present can forecast the occurrence, so every time an owner takes out fire insurance he admits that he does not understand how to cope with the situation. The fact is no one does. There is at present no very competent protection against fire risk.

The fire risk is very expensive. An eminent authority (Gorham Dana, manager of the Underwriters' Bureau of New England), puts our average fire loss in property alone as \$500 per minute night and day. That is an average yearly loss of 250 millions, due to fire alone. To this may be added 350 millions chargeable to indirect loss in maintaining fire departments, insurance companies, protective departments, etc., so that the total fire tax borne by the American people is something like 600 millions per year. This is truly appalling.

Fortune is waiting with a noose of gold to capture the man who can devise some way, some means to meet this condition and cut down even in a small percentage this enormous property loss. Furthermore, any device which prevents actual fire losses, at the same time saves insurance premiums, so that the reward will be direct and sure for the man who can solve the problem.

There is besides a humanitarian standpoint in this matter of fire protection. The loss of property, however enormous, cannot be compared with the loss of human lives every year because of the lack of efficient fire protection. Consequently, fame is an added incentive for the solution of this problem.

From the earliest times, water has been used to extinguish fire, and at the present day, it remains the chief and prac-

tically the only general means at our command. Before the beginning of the nineteenth century, the only protective systems were buckets filled with water or sand, placed at convenient stations. In some instances, and especially on ship-board, pumps were installed and used, but the general use of pumps has been of a

York and Berlin, installations were made. These systems connected by means of an ordinary Morse line, a series of watch towers wherein watchmen were stationed so that they could telegraph one another the location of a fire. With this combination of the electric telegraph and the steam fire engine a great advance was

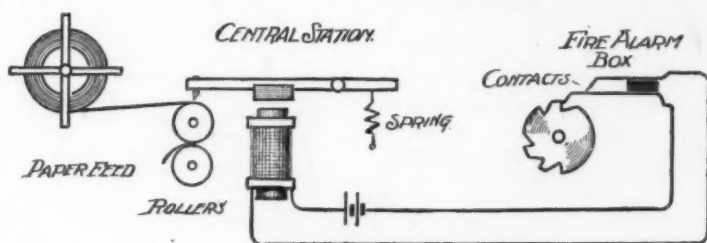


Fig. 1.—Simplified diagram of modern fire alarm box mechanism.

comparatively recent date. Water systems were practically unknown. It is interesting to note, that in the year 1800 there were but sixteen places in the United States that had water works. As late as 1850, only 83 towns had these systems. (The sixteen towns so equipped up to 1800 were: Boston, 1652; Bethlehem, Pa., 1754; Providence, R. I., 1772; Geneva, N. Y., 1787; Salem, Mass., 1795; Plymouth, 1796; Hartford, 1797; Portsmouth, Worcester, and Albany, 1798; Peabody, New York city, Morristown, N. J., Lynchburg, Va., and Winchester, N. Y., 1799; Newark, N. Y., 1800.) The bucket brigade and the hand pump were then the only means for fighting fires, and no regular organization was effected.

With the advent of the water works system came the great improvement in the form of the steam fire engine. This was similar to the modern fire engine and was merely the application of the steam engine to the fire pumps formerly operated by hand. But even with this powerful instrument at command a very serious defect existed in the system. That is, no means existed for quickly communicating with the fire department, if such existed, or for notifying the various individuals, where there was a volunteer system only. This difficulty was solved by the electric telegraph. Although the telegraph was invented in about 1832-1835, and made public at the latter date, not until sixteen years later was advantage taken of its great utility for fire alarm purposes. In 1851, in the cities of New

York and Berlin, installations were made. These systems connected by means of an ordinary Morse line, a series of watch towers wherein watchmen were stationed so that they could telegraph one another the location of a fire. With this combination of the electric telegraph and the steam fire engine a great advance was

made in the art of fire fighting. But the first systems were very inefficient and too costly to maintain in any but a large city. Improvements were soon made, and as early as 1850 Messrs. Farmer and Channing brought out the modern fire alarm "box." This system is an adaptation of the Morse system, wherein a wheel with

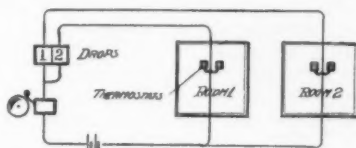


Fig. 2.—Diagram showing the circuit employed in finding the starting point of a fire.

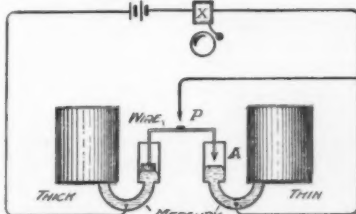


Fig. 3.—Form of U-shaped thermostat shown diagrammatically in Fig. 2.

proper engine house, either by hand or by an automatic repeater.

This system is now in use in nearly every city in the United States. The accompanying engraving illustrates the appearance of the apparatus on its ornamental post at a street corner. The code wheel is arranged to be driven by a clock spring and mechanism and the whole is contained in a weather-proof iron box or casing. Access is to be gained to the releasing handle by unlocking the outer door, the key to which is usually contained in a small iron box with a glass front. This glass front must be broken to secure the key for unlocking the box.



Electric system fire alarm station.

tance to the fire after the detection of the blaze and the delay occasioned by finding a fire alarm box and operating the same. Even then, after the fire apparatus has arrived at the box, it is necessary to find the exact location of the fire and to connect the apparatus to the nearest hydrant. Although the modern fire departments are remarkably well organized and the men are carefully trained to do all the necessary work in a surprisingly short time, still it is a fact that this system has a disadvantage of losing the first few minutes of time when the fire is just starting, and when it could most easily be quenched. To aid in determining the exact location of fire the electric enunciator has been very widely installed. This is an arrangement for indicating at a central point the building or the room in which the fire has started.

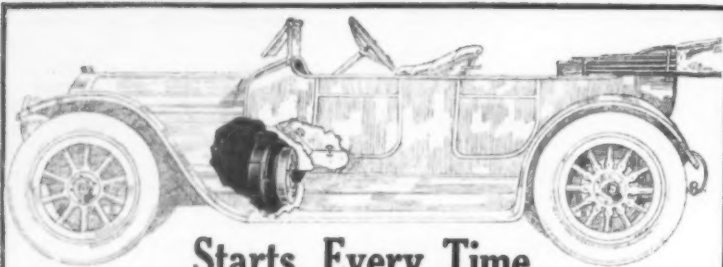
In fact, as early as July 25th, 1846, a patent was issued to an inventor by the name of Addison Smith of Perrysburg, Ohio. The diagram shown in Fig. 2 is a sketch of the circuit employed, and although the latter is remarkably simple, it is as complete as many of the modern installations. The patent exhibits a very efficient form of thermostat which is shown diagrammatically in Fig. 3. Two brass cylinders made air-tight are connected to U tubes which are partially filled with mercury in the nature of the well known air thermometer. The right hand cylinder having very thin walls heats quickly, and the air expands, forcing the mercury up to close the contact at the point "A," whenever the room is heated quickly as by fire. The other cylinder has thick walls and heats slowly, and in case of a general dangerous rise in temperature the contact at "P" is closed and the alarm "X" is rung and the appropriate drop is exhibited. Substantially the same scheme is widely in use to-day.

In about 1875, another important step was made to overcome the defects of the central fire station system. The so-called sprinkler system was invented. In this system, water pipes are run along the ceiling of the rooms of the building to be protected and about every six or eight feet apart an outlet in the form of a spray nozzle is provided. This nozzle is closed or shut off by means of a fusible plug usually an alloy of metals. The plug melts at about a hundred and sixty degrees. The water in the pipes being constantly under pressure, is forced out and sprays or sprinkles the space below it for an area of about 40 square feet. This is the usual space supposed to be protected by each nozzle. This system, when properly installed is claimed to be very efficient, and it is stated on reliable authority that about ninety per cent of fires originating in buildings protected by sprinklers are automatically extinguished. However, this figure is very misleading. The great difficulty is to keep in suitable working condition the complicated system of pipes and valves. There is constant danger of leakage or tampering with the pipes by unauthorized persons. In event of an actual fire unless someone is at hand to shut off the flow of water, the sprinklers will continue to flood the building. So, although the fire is put out the damage from water becomes excessive.

The cost of such systems is very high. It is estimated that the average cost per sprinkler, including the necessary piping, valves, and sprinklers, is about \$30 to \$40. This is exclusive of any meter equipment or alarm devices. This high cost is partially accounted for by the attitude which the management of water companies evince toward such installation. It is a peculiar fact that a regular charge of from \$25 to

(Concluded on page 217.)

<sup>1</sup>Of course we Americans insist on doing everything in the most recklessly generous fashion, and as a consequence our burden is far above that of European countries. Our per capita yearly loss is about \$2.50 as compared with Germany at about 50 cents, and Italy at about 12 cents, and the average for all European countries of about 33 cents.



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## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

**SKIRT-PLACKET FASTENER.**—J. E. FITZGERALD, 112 Cedar St., Roxbury, Boston, Mass. This placket fastener is arranged to cause the edges of the placket opening to close upon each other without a gap. It consists of two flat members, one of which is provided with hooks adapted to catch under the other member, and thus provide a continuous closure of the placket.

**HAT-PIN GUARD.**—L. RECHTSCHAFFEN, Manhattan, N. Y., N. Y. This pin is arranged to permit of quickly and conveniently placing the same in position on the end of the pin, to protect the point of the pin when the latter is in use for fastening a hat to the head.

### Electrical Devices.

**ELECTRIC SWITCH, CIRCUIT BREAKER, AND THE LIKE.**—D. K. MORRIS and G. A. LISTER, Carlton Works, Lockhurst Lane, Coventry, England. This invention relates to switches or circuit breakers of the thermal type. It comprises the combination with a tension member adapted to be heated by a current passing through or around it and means for retaining the switch or the like in the closed position, of a spring or equivalently controlled oscillatory strut like member on which the tension members is adapted to exert or modify an approximately end-on pressure and which can move through a certain angular distance on either side of a dead center.

### Of Interest to Farmers.

**HAY STACKER.**—H. A. DANIELS, Simeon, Neb. In this invention means is provided for permitting the draft animal to travel in any direction from the stacker while raising the fork, and wherein means is provided for returning the fork to original position and for cushioning the return so that the fork strikes the ground lightly and without jar.

**ATTACHMENT FOR HAY PRESSES.**—J. J. H. SAWYER, R. F. D. No. 2, Lexington, Ky. This invention comprehends mechanism controllable in part at the will of the operator, and in part automatically for threading the wire through the press and around the unfinished bale; for tightening the wire around the bale; and for measuring and cutting the wire into proper lengths to avoid waste of wire.

**WHEEL CULTIVATOR.**—S. T. HUDSON, deceased, Mary E. Hudson, A. H. Young, executors, Riverhead, N. Y. The invention comprises the combination with the frame, the drag-bars pivoted to the frame and carrying teeth or shovels, of a lever, a horizontally rotatable shaft to which said lever is attached, chains pendent from the angle arms of the shaft, and having stirrups which are applied to, and freely slidable on, the drag-bars. The invention relates particularly to stub-axe cultivators.

### Of General Interest.

**NEEDLE.**—O. D. BELL, 217 Fenimore St., Brooklyn, N. Y. A needle for fastening on large buttons in heavy garments has been provided by Mr. Bell's invention. It can also be used for fastening on price tags. The needle is provided with a clamping element in the form of a resilient arm which holds the thread.

**TOBACCO-CUTTING BOX.**—W. E. ROYSTER, Jr., Henderson, Ky. With this cutter a retail merchant may conveniently handle tobaccos which have been pressed together in strips or blocks of the full length leaf. A farmer or grower of raw leaf tobacco may qualify under the law as a manufacturer of tobacco and press his tobacco in shape to fit this apparatus, and after paying the tax on his tobacco, sell it directly to the merchant.

**METHOD OF MAKING COLORED PHOTOGRAPHIC REPRODUCTIONS.**—J. LEWISOHN, Manhattan, N. Y., N. Y. The invention pertains to a process in which use is made of the original blue color of a blue-print reproduction as one of the ordinary spectrum colors, and use is also made of red eosin for the red and aurantia for the yellow. The mixture of these three colors obtains substantially any of the spectrum colors.

**GARMENT BAG.**—D. B. FALK, Germania Bank Building, Savannah, Georgia. An improvement in garment bags or bags for holding garments is provided by this invention. It will be found to be useful in the delivery of garments as well as in protecting garments temporarily or from season to season.

**DEVICE FOR DETECTING SUSPENDED MATTER IN GASES.**—W. W. STRONG, 353 Oakland St., Pittsburgh, Pa. An object of the present invention is to provide a device in which a local circuit may be energized for the purpose of sounding an alarm, automatically regulating the draft or for any other purpose, whenever the gas has a certain amount of suspended matter present.

### Hardware and Tools.

**BALE-TIE BUCKLE.**—E. A. FRANTZ, care of Frantz Buckle Co., Weatherford, Texas. This invention is an improvement in bale-tie buckles and has for an object to provide a novel construction of buckle formed of a length

of wire in which the buckle is closed by the strain or stretch on the bale-tie.

**LOCK.**—B. KOTKOVSKY, Brooklyn, N. Y., N. Y. This invention has reference to locks of the tumbler variety, and an object of the invention is the provision of a lock in which a misfit key will revolve freely within the key casing. A further object is to provide a lock in which it is impossible to pick the lock.

**SAFETY RAZOR.**—L. SIEVEN, Manhattan, N. Y., N. Y. The inventor provides means for adjusting blades with reference to the work to be performed; provides a construction adapted for packing within small compass; and provides a construction arranged to facilitate the necessary cleaning of the tool.

### Machines and Mechanical Devices.

**FRUIT SIZER.**—L. R. SKINNER, Dunedin, Fla. This device automatically separates fruit such as oranges, grape fruit, lemons and the like into lots, each lot containing fruit of the same size. The device is positive in action, and will size the fruit without causing them to rub against one another.

**SEWING MACHINE ATTACHMENT.**—I. ROSENMAN, Manhattan, N. Y., N. Y. The intention here is to provide an attachment for moving a portion of the pocket strip to one side so that the corresponding needle misses the said strip portion with a view to provide a side entrance to the pocket for the insertion or removal of a stay.

**PNEUMATIC SCALE.**—S. E. HARBACH, Fort Smith, Arkansas. Mr. Harbach has secured two patents on pneumatic scales. The weighing is accomplished by a fluid, preferably air, instead of by a series of beams, weights or springs, etc., supported on bearings. It is claimed for the improved scale that it is more durable and more accurate than the customary type. Special provision is made for the reduction of friction of the movable parts. The scale may also be readily assembled or taken apart for inspection or adjustment.

### Prime Movers and Their Accessories.

**STEAM GENERATOR.**—H. A. TURNBULL, G. F. DAVIS, and A. J. B. TURNBULL, respectively of 50 Newton St., Surrey Hills; 39 Camberwell road, Camberwell, and 50 Newton St., Surrey Hills, Victoria, Australia. Among the objects which this invention has in view are while generating steam at high or low pressure, to automatically keep its own water level; also to automatically maintain a predetermined steam pressure; to provide against priming to raise steam quickly; to work with almost perfect safety, to enable one or more of the tubes to be removed without stopping the working of the generator.

**GAGE COCKS.**—T. W. GRIFFIN and C. J. RATHERS, 211 South Oak Street, Sapulpa, Okla. This gage is of such construction that when associated with a boiler in operative position it may have its entire outer portion broken away without disturbing the valve upon its seat. Hence it is particularly adaptable for use on locomotives where accidents are liable to occur which, with the usual gage cocks, might result in the escape of scalding steam into the locomotive cab.

### Railways and Their Accessories.

**NUT-LOCK.**—E. G. DAVIS, care of Wilmer T. Fox, Citizens' Trust Building, Jeffersonville, Ind. In this nut-lock a washer is employed having a polygonal eye adapted to embrace the nut, and a second relatively fixed bolt washer formed to engage the adjacent fish plates so as to hold the bolt washer against turning, the respective washers having interlocking parts.

### Pertaining to Vehicles.

**RESILIENT WHEEL.**—G. DORFFEL, 2316 East 27th St., Oakland, Cal. The invention provides a plurality of resilient members and a surrounding and coacting spider and frame structure which will hold the resilient members properly in place and present a substantially rigid structure having a resilient radial action. The parts are made substantially as duplicates so that any number may be assembled in a single wheel and thus present a wheel of any desired strength.

**NOTE.**—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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**Inquiry No. 9314.** This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from \$5,000 to \$10,000. The name of the party will be supplied to any of our readers on application.

**Inquiry No. 9315.** Wanted the name and address of a concern manufacturing novelty ink wells.

**Inquiry No. 9316.** Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

**Inquiry No. 9317.** Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvass.

**Inquiry No. 9318.** Wanted rollers and other appliances for extracting water and moisture from refuse, such as coir dust, with special reference for using it as a fuel.

**Inquiry No. 9319.** Wanted the name and address of concerns manufacturing novelties in table or pocket cutlery for the wholesale or mail order trade.

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**Inquiry No. 9321.** Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the time and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

**Inquiry No. 9326.** Wanted to communicate with those having inventive ability with a view of acquiring or assisting in developing an invention for mail order use.

**Inquiry No. 9325.** Wanted the name and address of some stamping concern in New England who could manufacture a window shade bracket, the materials to be used being 14, 16 and 18" gauge.

**Inquiry No. 9324.** Wanted—prices including discounts and full particulars of reliable and inexpensive voiturettes or motor cars for export.

## Electrical Fire Protection

(Concluded from page 215.)

\$50 is demanded of every four-inch connection made to the city mains. This is exclusive of the meter rent, which the owner is also forced to pay. Now the man who installs the most efficient form of sprinkler apparatus has to stand this charge merely for being connected to the city mains. The owner of a building without such protection is not required to pay any charge whatsoever, but can demand the installation of fire hydrants at his very door. Yet in the case of fire no charge is made for any amount of water required to be thrown upon his building, and such quantity of water is very much greater than would be required to extinguish the same fire by means of the automatic sprinkler. So in the case of a man owning, say, a \$100,000 factory or building who has expended about \$20,000 to adequately protect the same, a charge for every drop of water used is made. The improvident man, disregarding the safety of the community about him, is charged absolutely nothing for the water that may be necessary to extinguish the fire in his building.

The installation of such protection materially reduces insurance rates, but it often gives a false sense of security and the owner will reduce the amount of insurance carried. An incident illustrative of this condition occurred in New York city. An owner who boasted of his complete protective system, which consisted of four connections to the street main, was informed by an inspector that three of these connections were found closed, and, in fact, the valves to the mains had never been opened.

Happily the aid of the electric current has been secured to furnish a better protection in the matter of such installations. Instead of having the pipes constantly full of water, and thus exposed to the danger of freezing and corroding, thermostats are placed throughout the protected area, and upon a dangerous rise of the temperature the valves are electrically opened, and upon cessation of the blaze they are again closed automatically. By this means flooding is prevented. Electrical contacts are placed at every valve to prevent tampering with the device, and in case of unauthorized closures of such valves an alarm is rung at a central point.

By means of such improvements a more adequate protection is secured, but the prohibitive cost renders imperative a cheaper means of securing the same ends. Future developments along the lines of less cost will show an increased use of the thermostat and other electrical devices which have in the past shown themselves to be the most reliable and efficient means for securing fire protection.

## The Current Supplement

IN a paper read before the Railway Club of Pittsburgh, Mr. G. E. Ryder deals with the maintenance and operation of superheater locomotives, showing how, by proper attention to certain points in construction and operation, this type of locomotive effects economies over the type employing saturated steam.—Prof. C. J. Tilden's paper on the Kinetic Effects of Crowds is a contribution on a subject to which hitherto only occasional and passing attention had been given, namely, the effect of movements of individuals in a crowd, upon structures such as bridges, grandstands, etc., occupied by them.—Dr. A. Maverick, in an article entitled "Blunders Made by Nature," shows how the human body, so far from being perfectly adapted to its environment, has a number of natural features that positively invite disease.—A combination of the Ostwald process for making nitric acid from ammonia with the manufacture of calcium cyanamide is described.—H. W. Perry writes on Permanent Roads as an Economic Necessity.—The third instalment of Lieutenant Colonel J. E. Kuhn's article on transportation deals with ocean traffic.—M. Luckiesh reports on an analysis of the glare from paper, a phenomenon so injurious to the eyes of readers.

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(20)

## Technical Schools

**READER'S SERVICE**—Hardly a week passes but the Editor receives letters from readers of the Scientific American who ask him whether they shall send their boys to a technical school. Whether a boy shall become an engineer, a chemist or a naval architect are questions that puzzle parents. The Editor will be pleased to aid readers of the Scientific American in deciding the matter of technical education for their sons. Address: Educational Bureau.

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## The Industrial Need of Technically Trained Men.—VII.

The Possibilities That Await the Hydraulic Engineer.

By Chester W. Larner

**CHESTER W. LARNER** is hydraulic engineer for the Wellman-Seaver-Morgan Company of Cleveland. He has been identified with the hydraulic turbine industry since 1902. He has designed hydraulic equipment for water power development in various parts of the United States, Mexico, and Canada, notable among which are the Electric Development Company of Niagara Falls, the Mississippi River Power Company at Keokuk, Iowa; the Cedar Rapids Manufacturing and Power Company of Montreal, the Ontario Power Company, and Shawinigan Water and Power Company, Shawinigan Falls, Quebec.

He is a member of the American Society of Civil Engineers, the Canadian Society of Civil Engineers, the American Society of Mechanical Engineers, associate member of the American Institute of Electrical Engineers. He is a member of the Cleveland Engineering Society.—EDITOR.]

To the young man with a natural taste for engineering, many lines of work are presented. Construction work is roughly divided into civil, mechanical, and electrical engineering, but these divisions overlap to such an extent that it is necessary for a specialist in one branch to have a considerable knowledge of the other branches if he is to be a well-rounded engineer. It is for this reason that most courses in technical colleges are of a general nature until the last year, when the work becomes specialized. Indeed, it is an open question if all undergraduate engineering courses should not be alike, leaving specialized work until the post-graduate course.

Hydraulic engineering in its various applications offers many opportunities to the young engineer. The great works of this nature in progress on every hand are constantly attracting public attention. The Panama Canal, the great irrigation projects of the West, the numerous water-power developments all over the world, water supply systems for large cities, and the improvement of navigable rivers for water transportation, all suggest great present and future opportunities for the hydraulic engineer.

People at large do not as yet fully appreciate the growing importance of water-power development to the industrial and civic progress of this country. Although the development of water-power in small quantities for various industrial purposes has been common for many years, it was not until the perfection of the alternating current generator made long distance transmission possible, that it began to receive any marked attention. The hydraulic turbine or water-wheel has been, from its inception, the most efficient prime mover known, but until long distance electric transmission became a commercial possibility, water-power development was retarded by a serious handicap. Before that time, the power developed had to be used at the place where it was generated. But water-power sites are usually remote from large cities or industrial centers, where a good market for power exists. This gap is now bridged by the long distance transmission line. The fact that a good power site is many miles from a good power market no longer prohibits the development of that power. Plants are now in successful commercial operation, where the power has to be transmitted more than two hundred miles, and doubtless with the further development of electrical apparatus this distance will be materially increased.

Water-power development in this country is now in a state of marked activity, and the development is certain to keep step with the increase in the demand for electricity. Furthermore, the demand for electric power is certain to be far out of proportion to the present normal increase, due to the growth of our population and our industries. Water-power is ordinarily cheaper than steam power, and lower cost to the consumer stimulates the use of electricity not only for purposes for which it is already commonly used, such as lighting and power for factories and street railway lines, but also for many new purposes, such as the electrification of steam railroads, electro-chemical processes, metallurgical work, and many other industries which are dependent for commercial success upon cheap power. Already some of our largest railroads are using electricity developed by water power

to haul their trains, and no doubt the next twenty years will witness extraordinary progress in this direction. The aluminum industry in the United States and Canada alone is now using several hundred thousand horse-power of electricity, all generated by water-power. The electro-chemical industries of this country are at present far behind those of Europe, and the next decade will unquestionably be marked by unprecedented growth along these lines.

The young engineer in search of a profitable field for his efforts will do well to consider the opportunities afforded by water-power engineering. Many important plants have been already built, but as yet the field has hardly been scratched. The latest estimate of water-power developed in this country is about 5,000,000 horse-power, whereas the undeveloped horse-power is roughly estimated at between 60,000,000 and 80,000,000. Furthermore, practically all of the important plants built within the last ten years have been extending and increasing their capacity ever since they were built. Then again, many of the older plants are rebuilding and modernizing their equipment. This is a continuous process which will never end, and suffices to show that the work of the water-power engineer will not be finished even when all of the water-power is developed.

Handling water under low heads and at correspondingly low velocities is a different problem from handling it under high heads, where the velocity may be as high as four or five hundred feet a second. The tremendous force of such a stream can be appreciated only by those who have witnessed its destructive power. It will penetrate solid bodies as effectively as a drill, and in turn is itself almost impenetrable. It is impossible to shoot a rifle bullet through a high-pressure jet of any considerable size, and the blow of an ax will rebound from it as if it were a bar of steel.

The character of the plant in all its features must naturally change to suit these different conditions. The water must be diverted from the source of supply in different ways and different methods must be adopted to convey it to the power house. The design of the power house and the machinery must vary to suit conditions, and sometimes steps must be taken to regulate the flow of the river by means of controlling works built many miles from the plant. Often the water will be taken directly from the pond or forebay into the wheel chambers, and again it may be conducted for miles through tunnels or pipe lines to the plant, necessitating elaborate precautions to prevent bursting of the conduit if the flow of the water should be suddenly checked.

Such are the conditions which the hydraulic engineer has to face to-day. There is no lack of opportunity and there is no dearth of work. Men of ability and experience are unquestionably in demand, and no man taking up this work at the present time will fail for lack of opportunity.

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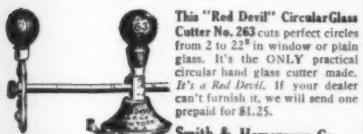
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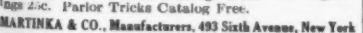
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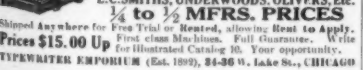
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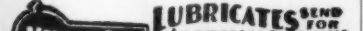
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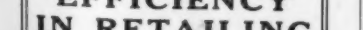


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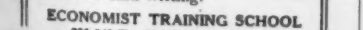
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(12851) J. W. S. writes: Will you please state in your "Notes and Queries" column what effect camphor has when added to gasoline for use as an automobile fuel? A. In their search for a cheaper or a more powerful fuel than gasoline for automobiles, motorists have tried almost every conceivable concoction of both volatile and heavy oils and have even mixed acids and camphor with the gasoline in search for the ideal motor fuel. Camphor has been tried many times, and while some reports state that its addition to the gasoline, in about one ounce to five gallons of fuel, will enhance the power of the engine in which it is used, recent tests in England seem to prove that no additional power is gained by its use. No official test has ever been reported, however, and the only way to demonstrate the value of camphor as a means of increasing the power of the motor, would be to make trial runs with and without the camphor in the gasoline, with the machine operating under exactly the same conditions in both instances. It is doubted whether any appreciable difference in power would be shown.

(12852) E. J. D. C. asks: In latitude 40 degrees north the sun rises at 4:28 A. M. on June 13th (date of earliest rising); on June 22nd (the longest day of the year) it rises at 4:29 A. M. and sets at 7:34 P. M.; while on the date of latest setting (June 27th) it sets at 7:37 P. M. I would like to ask: (1) Does this mean that each day between June 13th and June 27th the sun is rising a little more to the south and setting a little more to the north, and that the apparent path of the sun through the heavens at this time of year, is not parallel to its apparent path at the equinoxes, or in other words, not parallel to the earth's equator? Can you recommend to me any reliable text book dealing fully with this subject? A. The sun remains at the same distance from the equator on the day of the Summer Solstice, changing its declination only about one second of arc. It, therefore, rises and sets at the same distance north of the east and west points of the horizon on that day. This is true of any day except for the very small change of declination during the daytime. The fact that the sun does not rise at its earliest and set at its latest by the clock on the day of the Summer Solstice is due to the fact that noon or midday by the sun does not coincide with twelve of the clock, except on four days in a year. The difference between noon and 12 o'clock is called the Equation of Time and the subject is fully explained in the astronomy. We can supply you with "Young's Manual," price \$2.50 postpaid.

(12853) W. Y. asks: 1. In its path through space, the earth, during one lunation, travels roughly speaking one thirteenth of its orbit or about forty-four million miles. How many miles does the moon travel during this time? A. During a lunation the moon goes around the earth and also goes with the earth around the sun. The earth and the moon must be considered as revolving around their common center of gravity once each lunation. The distance from the earth's center to this point is 2,880 miles. This distance is called the radius of the monthly orbit of the earth's center (see "Young's Manual of Astronomy," section 200). It is this point which describes the path which is commonly called the orbit of the earth around the sun. The moon also makes one complete revolution around this point each lunation. We have never seen any statement of the length of the actual path of the moon in one lunation. (2) When the moon is in conjunction does it slow down to let the earth get ahead and then speed up? If so, does the earth change speed to accommodate the moon? A. Neither earth nor moon can be said to slow down or speed up as they move around their common center of gravity and at the same time around the sun. The motion of a point on the rim of a wheel of a carriage, as the center of the hub goes along the road, is similar to this. (3) How much greater is the maximum speed of moon and earth than their minimum? A. At perihelion the first of January, the earth moves over about 1 degree 1 minute 10 seconds in one day. At aphelion, which occurred on July 3d in 1913, it moved over about 57 minutes 13 seconds. From these numbers with the distances from the sun on those days you can compute the approximate velocities in miles per second. The same data for the moon, which we have not at hand, would give you the results for the moon. The variation in velocity is much greater for the moon because of the greater eccentricity of its orbit, which is 0.05491, while that of the earth is 0.01677. (4) Does the earth follow a sinuous course about the sun in the sense that the moon follows a sinuous course about the earth? A. The earth follows a sinuous path. Its center is alternately 2,880 miles within and without its orbit, as stated above.



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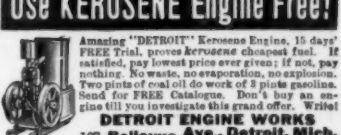
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## Details of The 1914 Hupmobile

Long-stroke, small-bore motor; cylinders cast en bloc, with enclosed valves; three bearing crankshaft, hollowed for circulation of oil; chain drive for magneto and cam shaft; unit power plant with multiple disc clutch; full floating rear axle; hood harmonized with body, without abrupt break at the dash; gasoline tank under the scuttle dash or cowl.

These are Hupmobile features which were new to the American market when the present type Hupmobile was introduced almost two years ago.

They are standard in the Hupmobile for 1914; many of them have been adopted by other American manufacturers; and a forecast of the 1914 European models published July 3 in *The Automobile*—the recognized authority—shows that nearly all of them are included in the latest Continental productions.

More than that, they remain Hupmobile standard because, in nearly two years of service, they have demonstrated their worth.

The body is unchanged, save for minor detailed improve-

ments. The back of the front seat, in the touring car, is upholstered; the doors are upholstered, with pockets, and given a more substantial appearance.

A rain-vision, ventilating windshield replaces the present type, though still hinged at its point of attachment to the car, so that it can be lowered forward if desired.

The capacity of the gasoline tank is increased approximately three gallons.

Oversize tires—33 x 4-inch—will be regular equipment for the \$1200 car; also demountable rims, one extra rim and rear tire carrier, which clamps the rim without touching the rubber casing.

An electric horn, concealed under the hood, is included in the equipment. The horn button is at the center of the steering wheel.

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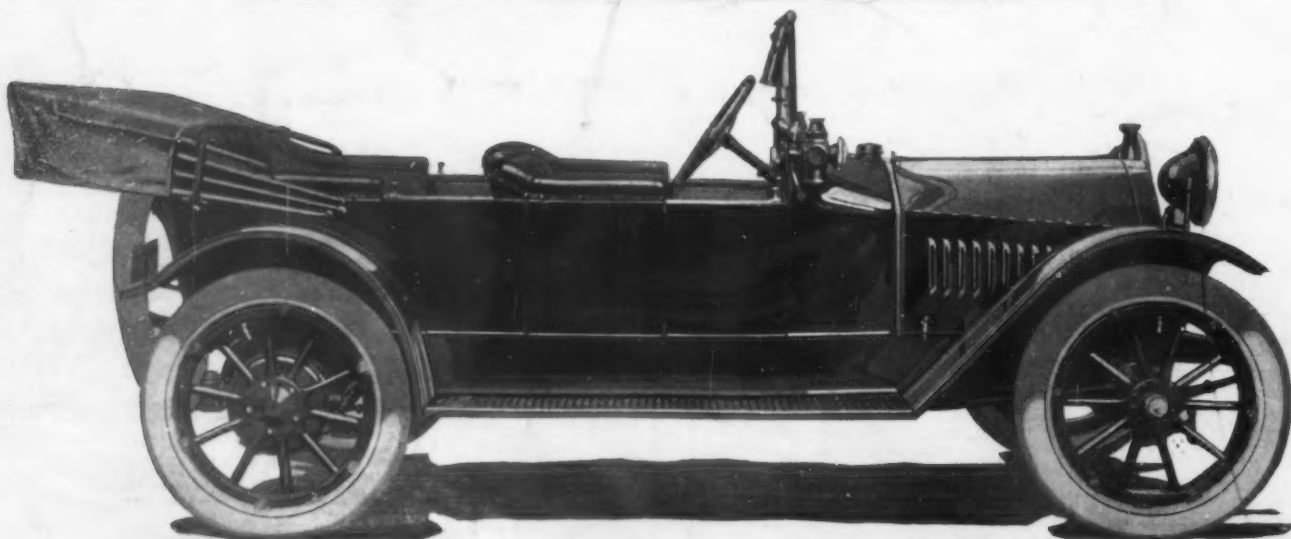
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